RADIO-ELECTRONICS

APRIL 1955

TELEVISION • SERVICING • HIGH FIDELITY

HUGO GERNSBACK, Editor

In this issue:

Horn Antenna For Fringe Areas

Ideas in Horn Speaker Systems

Sideband Modulator for Marker Generator

Intercarrier Buzz

TV Picture Smear

35¢ U. S. and CANADA

Detecting Strain in Vacuum Tube Envelopes

(See page 4)

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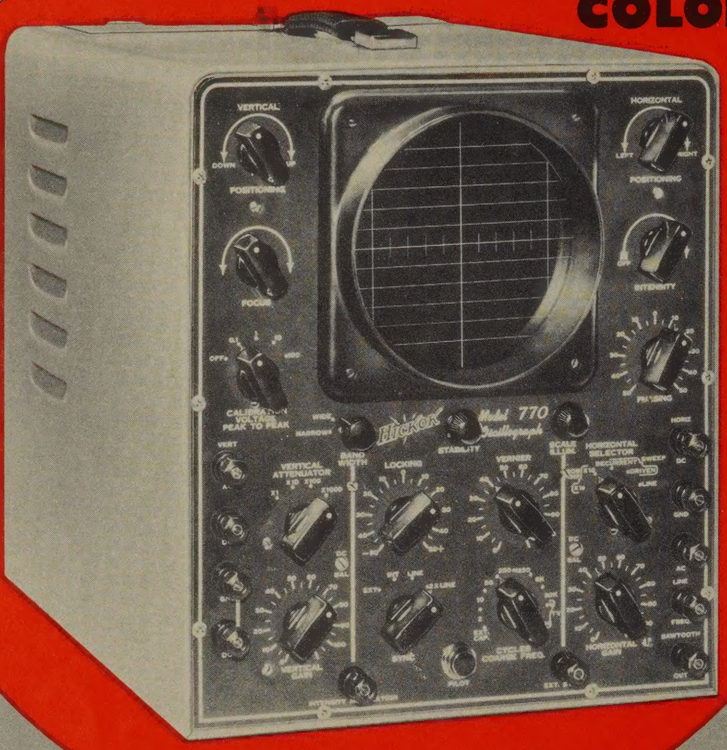

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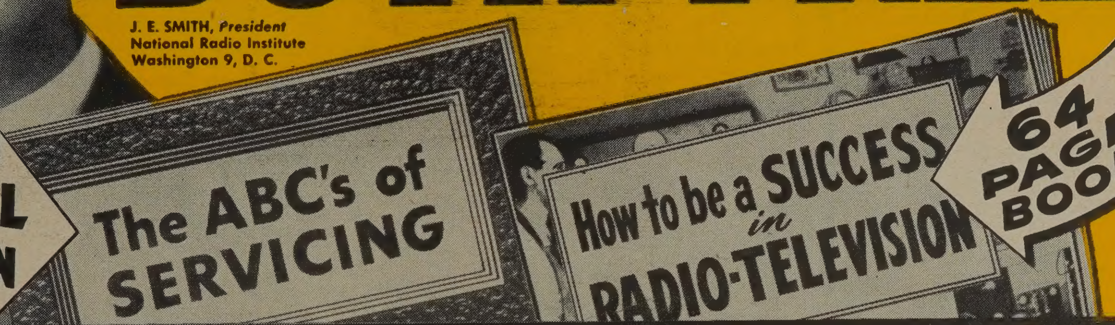

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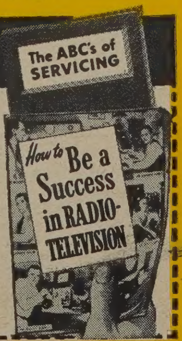

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ON THE COVER

(Story on page 53) Strain patterns in the stem presses of miniature vacuum tubes, as revealed by the polariscope.

Color original by Larry Ankersen, Sylvania Electric Products

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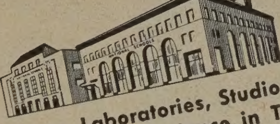

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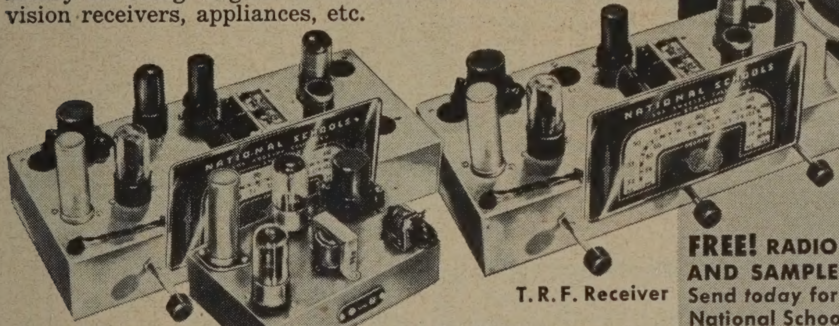

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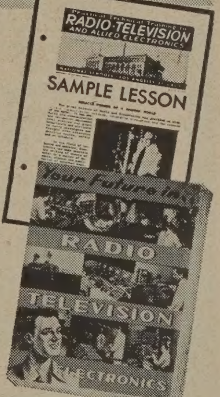

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the Radio month

NEW AM RADIO TRANSMITTER, known as the Ampliphase and developed by RCA, represents a significant advance in AM transmitter design. It requires half the space of comparable broadcast equipment and will reduce operating costs by 50%. The unit will be available to radio broadcasters late this year.

Producing 50 kw, the maximum power type transmitter uses phase-modulation principles to produce standard broadcast amplitude modulation. Its circuitry permits two phase-modulated amplifiers to produce a combined power equal to the output of much larger AM transmitters.

To produce 50 kw of modulated signal, a conventional AM transmitter must be able to generate about 35 kw of audio power. The Ampliphase transmitter makes it possible to produce the same signal with only a few watts of audio power.

The Ampliphase circuit has been used successfully in foreign equipment and is particularly advantageous for high-power transmitters operating at 50 kw and above.

TRANSISTOR MANUFACTURE by automatic means is foreshadowed by an experimental machine that carries out a series of 15 steps in making transistors. The equipment was demonstrated recently at the Bell Telephone Laboratories by R. L. Wallace and R. P. Riescz, who originated and developed the equipment.

In an n-p-n transistor there is a narrow layer of positive type germanium sandwiched between two pieces of negative type. The whole forms a fine wire, and the only way to find the positive layer is to explore the wire slowly with an even finer one while watching a meter for an indication that the nature of the material has changed.

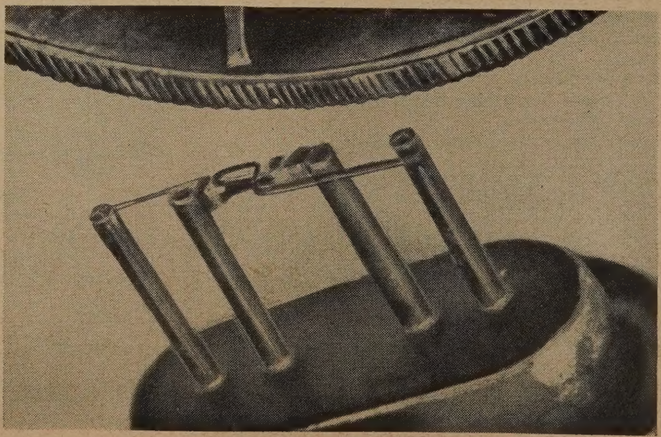
Transistors for research must be highly precise, Dr. Wallace pointed out. The careful process of searching for the positive layer, to which the base connection must be attached, is extremely fatiguing, and tired workers turn out a large percentage of transistors that must be rejected.

The automatic device causes a fine gold wire (to be used as the base connection) to travel along the length of the junction transistor in steps of 1/20,000 inch. The machine discovers the positive layer and measures its width. Then—on a return trip—it welds the wire to the exact center of the p layer. The other end of the gold wire is then connected to the external base lead of the transistor.

If the transistor is to be of the tetrode type (the machine was designed especially for such transistors), the unit is flipped over and another base terminal is attached to the other side of the p layer. The transistor tetrode thus produced is then given three electrical checks which indicate its most important characteristics. The whole process can be performed in less than a minute.

LIFE EXPECTANCY of radio and television receivers made with printed circuits was estimated at from 8 to 10 years by D. E. Yost of G-E at a symposium on printed circuits at the University of Pennsylvania. He said the survey also disclosed that silver migration, at one time considered a

(*Continued on page* 10)



Completed transistor shown next to dime.

serious problem with printed circuits, was virtually nonexistent in radio and television receivers.

Silver migration caused deterioration of printed circuits after a time, rendering the instrument useless. Yost said this was particularly true in areas with high humidity. However, the high heat of radio and television receivers dissipates the moisture, even in areas of high humidity.

AMERICA–EUROPE TV LINK by way of a television submarine cable is not far fetched. In a paper describing details of the proposed trans-Atlantic telephone cable between Newfoundland and Scotland, presented at the Winter General Meeting of the American Institute of Electrical Engineers, several internationally known engineers brought up the possibility of America and Europe exchanging television programs in the future.

They stated, "A trans-Atlantic submarine cable is a long-range goal worthy of serious study and by no means to be dismissed as impractical of eventual attainment. The transistor looms as a development which has the potentialities for making possible long, deep-water submarine cables with much greater communication capacity than can be realized with repeaters employing thermionic tubes."

It is expected that 1956 will see the completion of the first trans-Atlantic telephone connection via submarine cable.

TV SERVICE MONTH, a nationwide promotion campaign, is being sponsored by G-E. It will run from April 19 to May 19 and feature a $25,000 ($10,000 first prize) cash prize contest. Mr. J. M. Lang, general manager of G-E's Tube Department, in announcing the plan said that the concept of a *TV Service Month* will be publicized through every possible channel to focus attention on the service dealer as a friend and neighbor and to call for direct action in ordering long-put-off repairs.

The program will be kicked off by publication in *Look* magazine of a directory of the thousands of service dealers who handle G-E tubes. A *TV Service Month* emblem that identifies each dealer's shop as a headquarters for the $25,000 jingle contest is one of the many promotional aids. Another is a talking postcard which customers can play on their phonograph.

LONG - DISTANCE WAVEGUIDE, a new and radically different medium for transmitting television and telephone conversations over long distances, has been used successfully in experiments by Bell Telephone Laboratories. Bell scientists believe the new waveguide may someday simultaneously carry tens of thousands of cross-country telephone conversations along with hundreds of television programs.

The waveguide is made of hollow tubing (see photo) approximately 2 inches in diameter. The tubing is constructed of a thin copper wire, very tightly coiled—like a spring under pressure—and wrapped inside a flexible outer coating which holds the coiled wire in place. The tube need not be straight and can carry signals around corners.

Bell Labs new long distance waveguide.

Although this new form of transmission, markedly different from modern cable or radio relay systems, is still in the experimental stage, a recent long-distance test was made in a copper pipe 500 feet long. Engineers bounced signals back and forth in the tube for distances of 40 miles. They calculated that in comparison the same waves could have traveled only 12 miles in a coaxial cable with the same loss in strength.

The new transmission system operates in a frequency range so high that it does not have a name. The super-high-frequency range goes to 30,000 mc—the carrier frequency for the new waveguide is about 50,000 mc.

A major difference between transmission through the new waveguide and through previous systems is that the higher the frequency in the waveguide, the less the loss through attenuation. This is exactly the reverse of other forms of transmission.

FACSIMILE playing important role in revolutionary new type of ticket and reservation center at the Pennsylvania Railroad's Thirtieth Street Station in Philadelphia. When ordering a reservation, the ticket seller selects a preprinted coupon showing date, time and place of departure, destination, accommodation and car number. He places this coupon in a high-speed facsimile machine which immediately reproduces a Pullman or reserved seat coach ticket.

The new setup also provides for direct facsimile transmission of reserved space tickets into offices of subscribers in the Philadelphia area. An order form is transmitted by facsimile from the subscriber's office to the ticket office, and the ticket ordered is immediately transmitted to a subscriber. END

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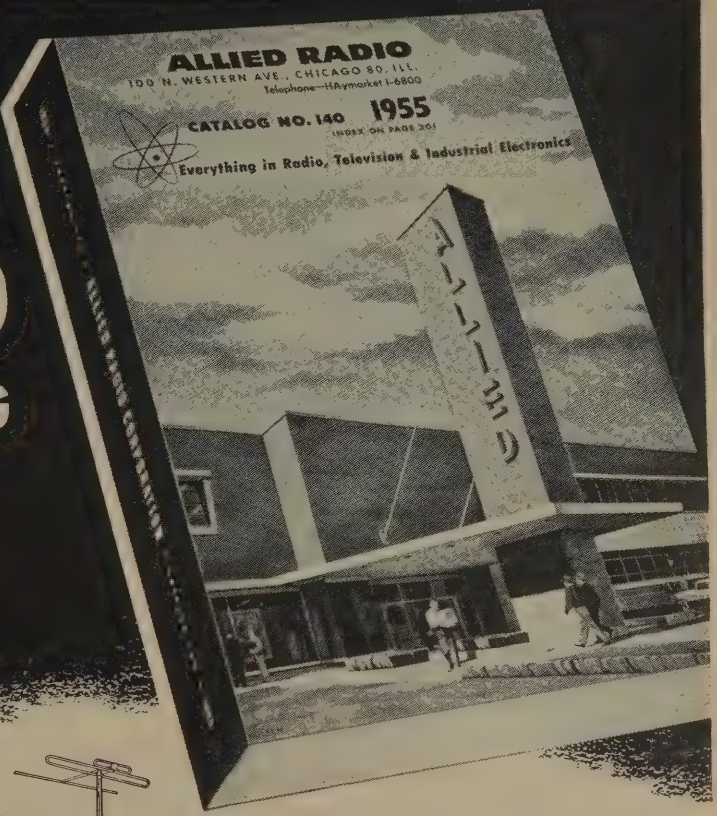

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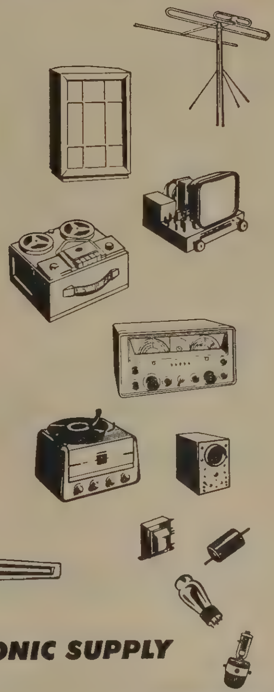

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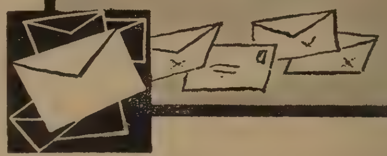
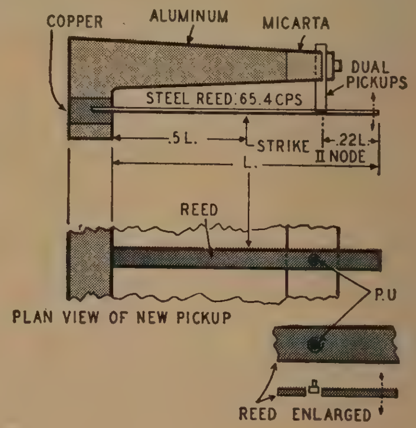


PIANO CORRECTION

Dear Editor:

Unfortunately there is an error in Fig. 1 of the Stringless Electronic Piano article (February, 1955). As shown, the dual pickups are at the tip end of the reed, whereas they actually are located at points which are about 22% of the total reed length from the tip end, where the second partial has a node. This was stated in the text.



A later model uses only one pickup at this same point, in a hole in the reed. This dual-opposed pushpull action also neutralizes translation of any accidental lateral reed vibration. Additionally and importantly, it increases the output tone dynamic range, from high to low reed vibration amplitudes, by shortening the air gap between the reed and the pickup head at high-amplitude vibrations. This is due to the slight double curvature of the reed while the second partial is initially present, which shortens the distance between its fixed end and the tip end side of the reed hole, where the pickup capacity is concentrated.

B. F. MIESSNER
Morristown, N. J.

1-TUBE CIRCUIT?

Dear Editor:

I wish to exclaim as did Mr. Noble D. Carlson (January) on Color Coded Clips. On page 166 of your January issue you have a novel British one-tube deflection circuit. This circuit contains two tubes—it has a damper.

The circuit was apparently abandoned years ago by U. S. set manufac-

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You get actual experience aligning TV receivers, diagnosing the causes of complaints from scope patterns, eliminating interference, using germanium crystals to rectify the TV picture signal, obtaining maximum brightness and definition by properly adjusting the ion trap and centering magnets, etc. There isn't room on this or even several pages of this magazine to list all the servicing experience you get.

UHF & COLOR TV Making New Boom

Installing front-end channel selector strips in modern UHF-VHF Television receivers and learning UHF servicing problems and their solution is part of the practice you get. To cash in on the coming color TV boom you'll need the kind of foundation in knowledge and experience this training gives.

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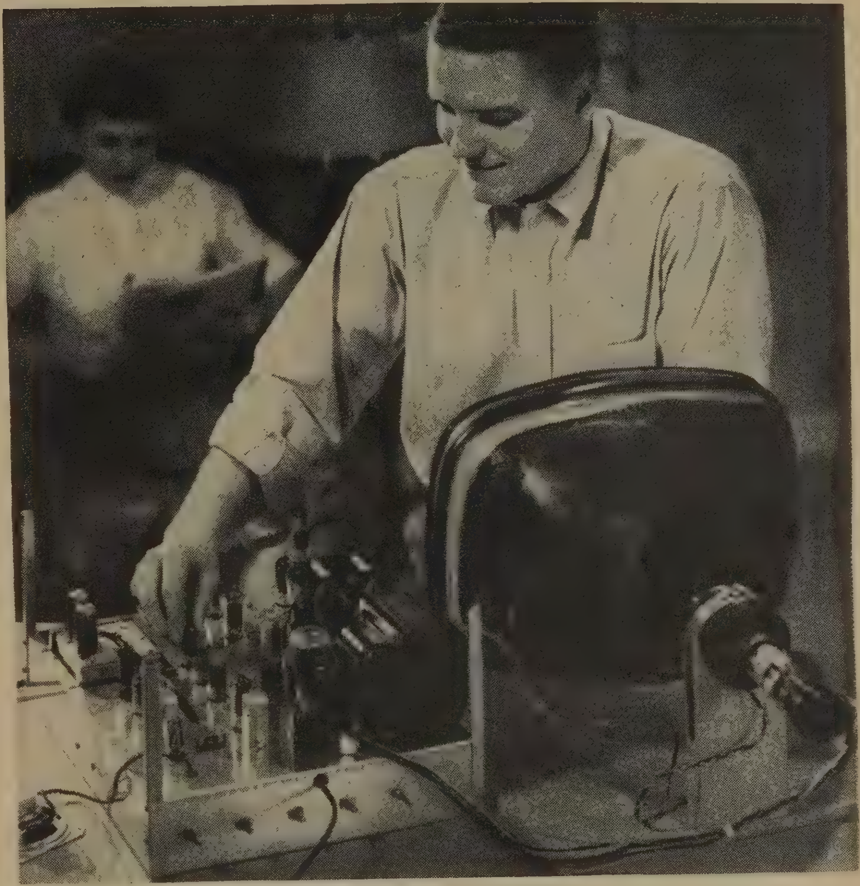
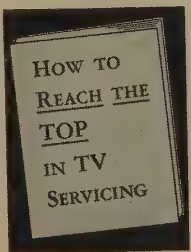
Once again—if you want to go places in TV servicing, we invite you to find out what you get, what you practice, what you learn from NRI's new course in Professional Television Servicing. See pictures of equipment supplied, read what you practice. Judge for yourself whether this training will further your ambition to reach the top in TV servicing. We believe it will. We believe many of tomorrow's top TV servicemen will be graduates of this training. Mailing the coupon involves no obligation.



Train at home easily, quickly, for TV's top servicing jobs. NRI's Professional Television Servicing course includes a 17-inch picture tube and all other tubes and components to build a complete TV Receiver, Oscilloscope, Signal Generator, H.F. Probe. Complete training, including all equipment, available now for a low introductory price—under $200 on easy terms.



National Radio Institute, Dept. 5DFT
16th and U Sts., N.W., Washington 9, D. C.

Please send my FREE copy of "How to Reach the Top in TV Servicing." I understand no salesman will call.

Name.................................Age..........

Address...

City.............................Zone....State......

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It's a

AND WOMEN BUY

A Crossley, Incorporated survey shows that this Seal influences 53% of *all* women in their purchases of everything from raisins to refrigerators . . .

and . . . *CBS TUBES* have the Good Housekeeping Guaranty Seal! When you

SO-O-O-O ADVERTISES

CBS is the *first and only tube* manufacturer to address its advertising to women.

CBS tubes will be consistently advertised throughout the year in Good Housekeeping and Life, reaching 17,171,419 readers every time an advertisement appears!

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turers. Refer to Photofacts folders around 1949 or look up an old Bendix diagram. They *really* had a one-tuber.

CHARLES SAMUELSON
Youngsville, Pa.

(Combination horizontal oscillator and output stages using one single-purpose tube have been used by several manufacturers in a few models. This practice was not widely adopted and the number of sets using one-tube horizontal deflection circuits is so small that many technicians have never seen or heard of them. The one-tube British horizontal deflection circuit was described not because we felt that it was previously unheard of but because we believe it is rare and unusual.

We still consider the circuit a one-tuber because the 6CD6-G will oscillate with the damper removed from the circuit. If you want to see a one-tube oscillator and output circuit without a damper, take a look at the circuit of the Muntz M-158 or M-159.

The output tube, called the horizontal output and oscillator, is fed directly from the output of the sync separator. —*Editor*)

CLARIFYING THE ISSUE

Dear Editor:

Some people seem to feel that I advocate very complex articles that cannot be understood by any but the best trained individuals in the electronics field. Possibly this feeling is the result of reading the Correspondence column, December, 1954.

Prior to October, Mr. Dorf (author of the articles I questioned) accused me of advocating involved articles beyond the comprehension of his readers. His language is much the same as that in the December column.

Please allow me to quote from a letter that I sent Mr. Dorf on October 3, 1954, a date considerably prior to your December issue. "You have missed the point of my letters. I'm not accusing you of overly simplifying discussions or of lacking to give full development to background and math involved. I realize as well as you that the majority of readers of RADIO-ELECTRONICS do not have the technical tools to understand all the math and development that could accompany an article. I'm accusing you of leading the readers to a wrong conception of some of the points you discuss. Any diagrams, equations and statements of principle in my letters are for your benefit, so that you can see your error demonstrated, as I do not feel you would be inclined to believe me if I merely tell you that you are wrong. It is one thing to simplify and another thing to tell an untruth. And it is precisely the readers without the technical understanding and background who should be protected from the possibility of an author starting them down a path of misconception. . . ."

WILLIAM HOLM
East Lansing, Mich.

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TAKE THAT FIRST BIG STEP!
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A PROVED CAREER-PREPARATION PLAN THAT WORKS!

This free book has brought success home to thousands of men just like you! They are now enjoying responsible jobs, good pay and the good things of life. So can you! In less time than you think! We tell you how you can carve out a bigger better-paying job. Our proved career-preparation plan works because it was written by authorities who know exactly what the varied electronic industries want, need and expect from you!

ELECTRONICS' FUTURE CAN BE YOUR FUTURE

You can't keep up with the tremendous changes in the electronic industries. What's predicted for next year becomes outdated in a few months! All phases of the electronic industries are experiencing phenomenal growth. There are thousands of career openings, big ones. Industry can't find *enough* trained manpower to fill them—in manufacturing, testing, servicing, broadcasting and telecasting.

TAKE TV FOR EXAMPLE!

Four hundred and six stations are on the air! Many more are building or in the plans stage; 32,859,915 sets are in use. Color TV is just starting to really come alive! This same phenomenal growth picture is repeated in every phase of business employing electronics — crime prevention, aeronautics, fire-fighting, communications, to name but a few. CREI has the plan to keep you moving upward, to help you assume your rightful place!

CREI GRADS ARE IN DEMAND!

The big companies know CREI men have what it takes! CREI grads are at work in America's biggest corporations, in positions ranging from technicians to engineers to top management. Companies such as United Air Lines, Canadian Broadcasting Corporation, Trans-Canada Airlines, Sears-Roebuck and Co., Bendix Products Division, All-American Cables and Radio, Inc., and Radio Corporation of America, are now paying for CREI training for their own technical staffs. Our placement bureau has more requests for CREI-trained men than we can presently supply.

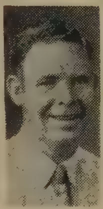
CREI GRADS EASILY PASS FCC EXAMS!

You start feeling the benefits of CREI training right away, either with your present connection, or with a future employer. You'll have all the training you need to secure your FCC commercial license.

ACT NOW! TAKE THAT FIRST BIG STEP!

Fill out and mail the coupon. When you do, you'll be on the way to higher pay, a better job and complete career security. Act right away. Send for your *free* book today.

THOUSANDS LIKE YOU HAVE SUCCEEDED WITH CREI'S PLAN! "CREI TRAINING IS BEST"



"—I chose CREI training upon recommendation of two top engineers. Before I had completed the course I became transmitter chief of a 5 KW station. I am now employed as a technician at a 100 KW TV station, and in spare time have a good TV sales and service business. Anyone interested in his electronic future should have CREI training." . . . —Arlie D. Patton, San Antonio, Texas

"—I know of no case in which a man who applied himself and completed the CREI course failed to better himself through promotion and increase in salary." . . . —Wendell L. Fraser, San Diego, Calif.

"—CREI has raised me to professional status as a radioman. Thanks to your instructors who always gave me needed help." —Victor Mentzer, Wilmington, Del.

"—I have been in radio and electronics for 24 years. I fully recommend CREI as the best school I have seen." —L. McManus, Montreal, Canada

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Street..

City.............................. Zone........ State..................

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To help us answer your request intelligently, please give the following information:

EMPLOYED BY..

....

TYPE OF PRESENT WORK..

....

SCHOOL BACKGROUND..

....

ELECTRONICS EXPERIENCE..

....

IN WHAT BRANCH OF ELECTRONICS ARE YOU MOST INTERESTED?

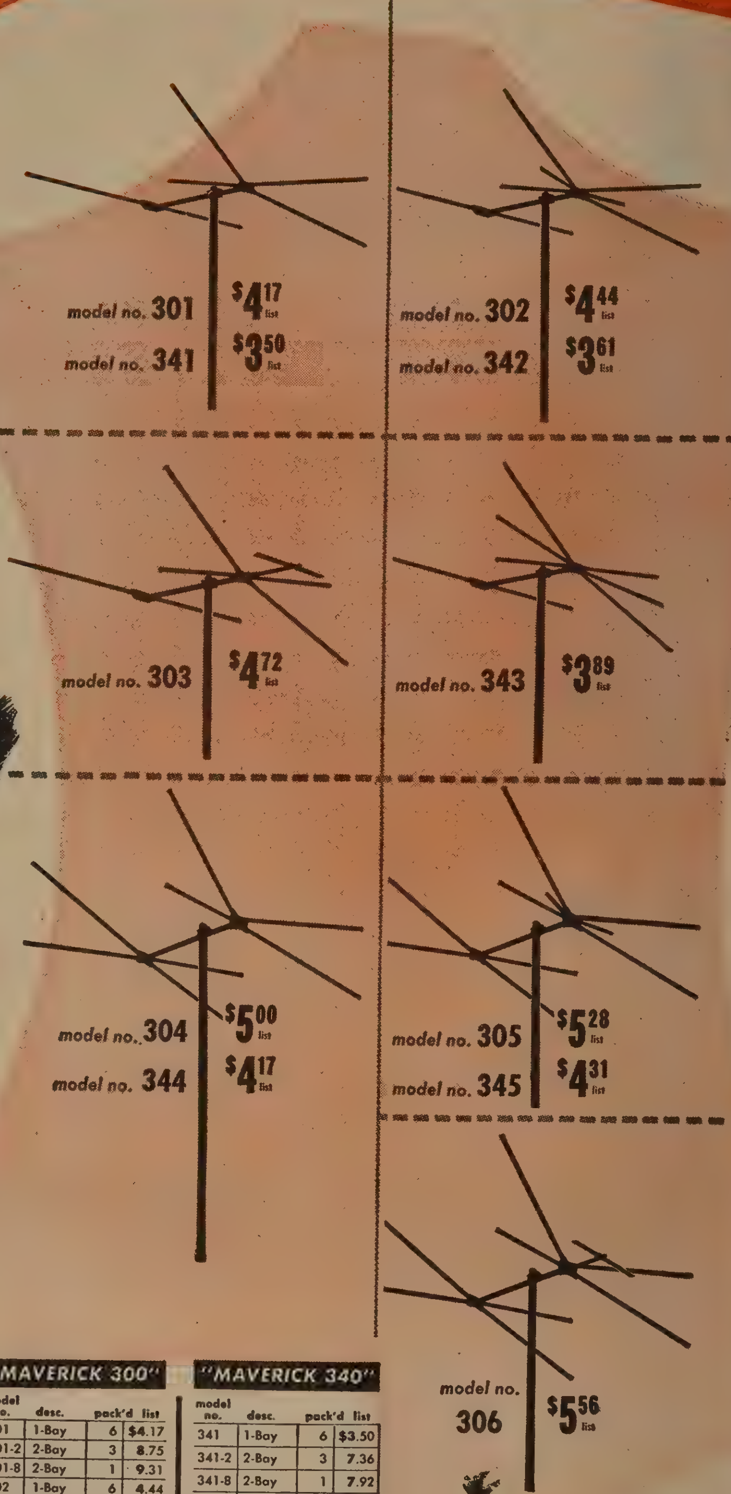
....

....

CHANNEL MASTER

steers you to the greatest conical values ever offered!

the New "MAVERICK"



Never before such a complete line of conicals at such fabulous LOW PRICES!

Low-priced conicals? Here is the LOWEST-PRICED, fullest conical line you've ever seen—a complete series of 22 different models. Checked out and approved by the Channel Master laboratory, every "MAVERICK" antenna provides outstanding Broad Band reception wherever conical antennas find application. Available both "Super-sembled" and non-assembled, the "MAVERICKS" are, without doubt, today's most sensational antenna buy.

"MAVERICK 300"

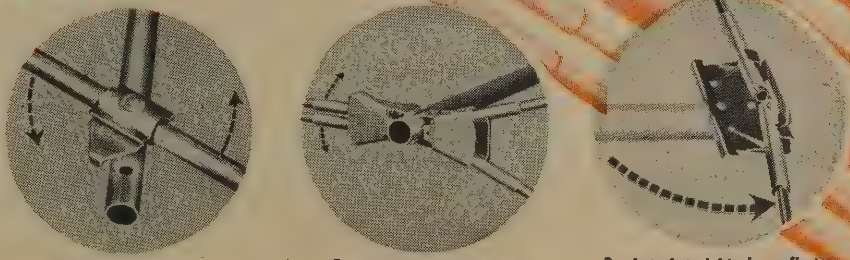
model no.	desc.	pack'd	list
301	1-Bay	6	$4.17
301-2	2-Bay	3	8.75
301-8	2-Bay	1	9.31
302	1-Bay	6	4.44
302-2	2-Bay	3	9.31
302-8	2-Bay	1	9.86
303	1-Bay	6	4.72
303-2	2-Bay	3	9.86
303-8	2-Bay	1	10.42
304	1-Bay	6	5.00
304-2	2-Bay	3	10.42
304-8	2-Bay	1	10.97
305	1-Bay	6	5.28
305-2	2-Bay	3	10.97
305-8	2-Bay	1	11.53
306	1-Bay	6	5.56
306-2	2-Bay	3	11.53
306-8	2-Bay	1	12.08
301-3	Conn. Rods		.56

"MAVERICK 340"

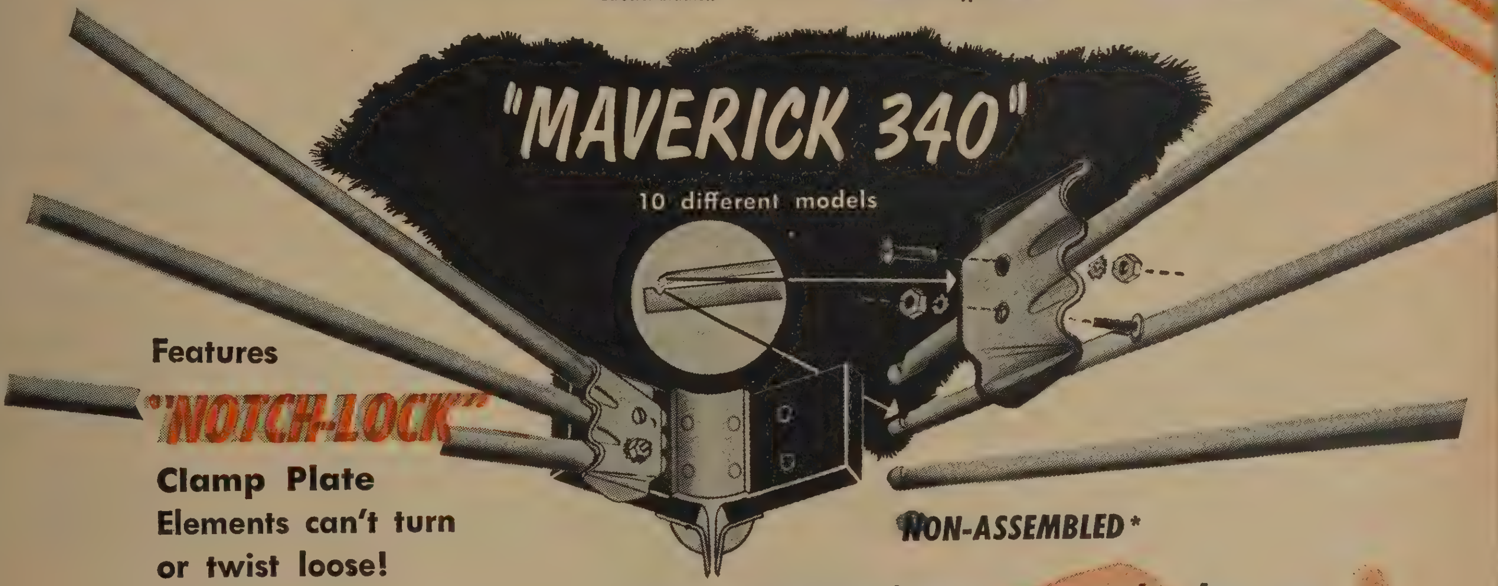
model no.	desc.	pack'd	list
341	1-Bay	6	$3.50
341-2	2-Bay	3	7.36
341-8	2-Bay	1	7.92
342	1-Bay	6	3.61
342-2	2-Bay	3	7.64
342-8	2-Bay	1	8.19
343	1-Bay	6	3.89
343-2	2-Bay	3	8.19
343-8	2-Bay	1	8.75
344	1-Bay	6	4.17
344-2	2-Bay	3	8.75
344-8	2-Bay	1	9.31
345	1-Bay	6	4.31
345-2	2-Bay	3	9.03
345-8	2-Bay	1	9.58
341-3	Conn. Rods		.56

The **first** and **only** full line of conical antennas completely "Super-sembled"

No hardware, no tools, no tightening— pops open, ready for the mast!



Director bracket. Bracket of X-type reflector. Bracket of straight- bar reflector.



Features "NOTCH-LOCK" Clamp Plate
Elements can't turn or twist loose!

This exclusive feature, until now, has been available only in much higher-priced models.

*This **quality** line carries the lowest price-tags ever seen on conical antennas!*

- Installs in a matter of minutes.
- Most popular conical arrangements.
- Finest materials; durable, rugged construction.

*** Extra Preassembly Feature!**
On all models with straight-bar reflectors, the reflector element is completely *preassembled* for snap-open installation.

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Write for complete technical literature

your KEY
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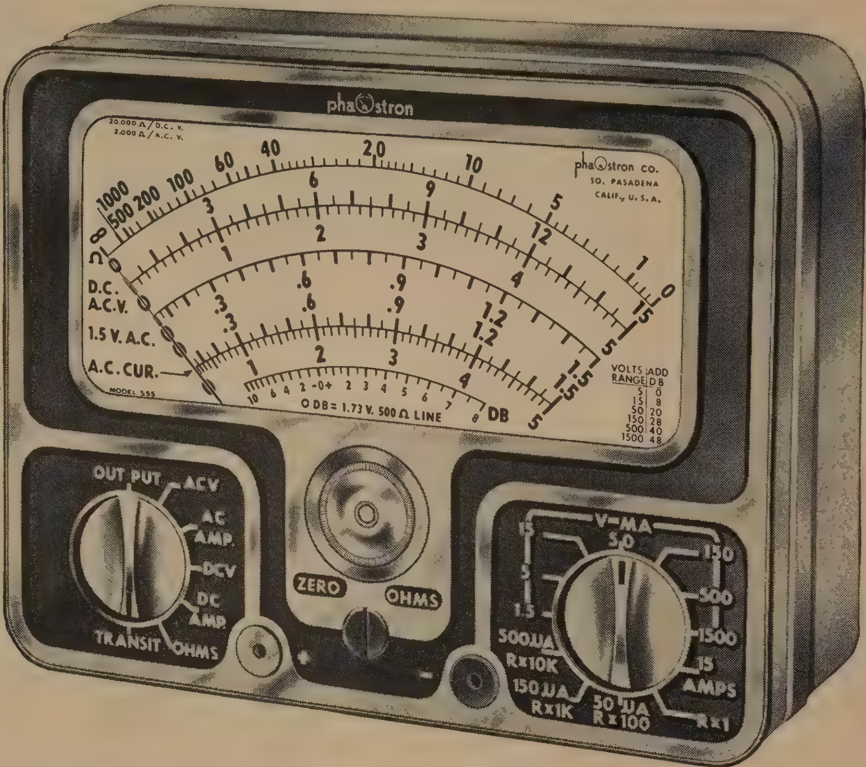
"555" metal-cased
the NEW LOOK in MULTIMETERS

an instrument of *PERMANENT ACCURACY*



in a case that *WON'T BREAK*

POCKET SIZE WITH A 4 7/8" LENGTH SCALE

WE LEAVE IT TO YOU

WOULD YOU BUY A PLASTIC-CASED WRIST WATCH . . .

if you *could* buy the finest movement in a magnetically shielded metal case?

Phaostron, world famous manufacturer of ENVIRONMENT FREE PRECISION AIRCRAFT EQUIPMENT for Military and Industrial uses introduces a new concept in Multimeters. This magnetically shielded, metal-cased "555" compares with plastic-cased multimeters as a fine watch in a precious metal case would compare with a plastic wrist watch.

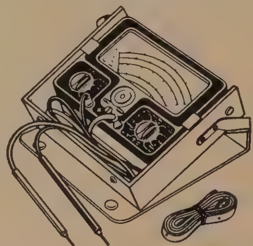
The shielded, shatterproof and anti-magnetic case insures continued accuracy and integrity of this instrument for years to come.

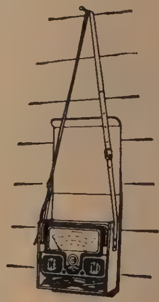
Phaostron "555" Multimeter incorporates more ranges, including AC current, greater visibility, simplified and functional controls and the greatest value offered to date.

See the Phaostron "555", note its many outstanding features, its beautiful satin chrome case, its compactness and light weight, and you will know why

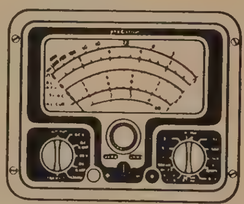
"YOU CANNOT BUY BETTER"

AC CURRENT RANGES
SEPARATE RANGE & FUNCTION SWITCHES
ONLY 2 JACKS



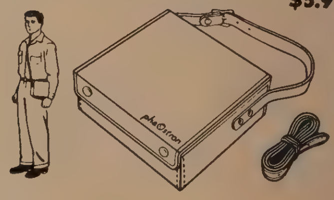


COLOR CODED SCALES ARE RED, GREEN, BLUE & BLACK
ACCURACY 3% DC, 4% AC



PANEL MOUNTING ADAPTER **$1.50**

GENUINE LEATHER CARRYING CASE
$5.95



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$39.95 *complete with probes and batteries*
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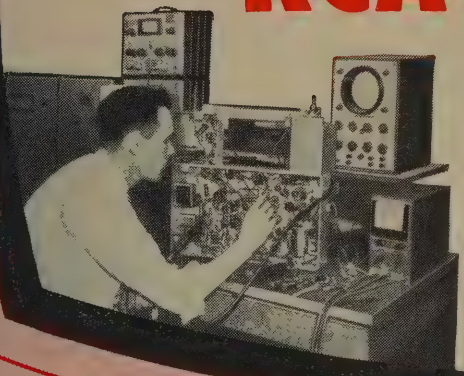
Home Study Courses in TELEVISION SERVICING offered by RCA INSTITUTES



Study Television Servicing—from the very source of the latest, up-to-the-minute TV and Color TV developments. Train under the direction of men who are experts in this field. Take advantage of this opportunity to place yourself on the road to success in television. RCA Institutes, Inc. (A Service of Radio Corporation of America), thoroughly trains you in the "why" as well as the "how" of servicing television receivers.

FIRST HOME STUDY COURSE IN COLOR TV SERVICING

Now you can train yourself to take advantage of the big future in Color TV. RCA Institutes Home Study Course covers all phases of Color TV Servicing. It is a practical down-to-earth course in basic color theory as well as how-to-do-it servicing techniques.

This color television course was planned and developed through the combined efforts of instructors of RCA Institutes, engineers of RCA Laboratories, and training specialists of RCA Service Company. You get the benefit of years of RCA research and development in color television.

Because of its highly specialized nature, this course is offered only to those already experienced in radio-television servicing. Color TV Servicing will open the door to the big opportunity you've always hoped for. Find out how easy it is to cash in on Color TV. *Mail coupon today.*

HOME STUDY COURSE IN BLACK-AND-WHITE TV SERVICING

Thousands of men in the radio-electronics industry have successfully trained themselves as qualified specialists for a good job or a business of their own—servicing television receivers. You can do this too.

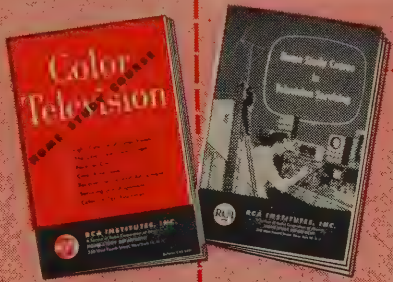
This RCA Institutes TV Servicing course gives you up-to-the-minute training and information on the very latest developments in black-and-white television.

As you study at home, in your spare time, you progress rapidly. Hundreds of pictures and diagrams, easy-to-understand lessons help you to quickly become a qualified TV serviceman.

There are ample opportunities in TV, for radio servicemen who have expert training. Mail coupon today. Start on the road to success in TV Servicing.

SEND FOR FREE BOOKLET

Mail coupon in envelope or paste on postal card. Check course you are interested in. We will send you a booklet that gives you complete information. *No salesman will call.*



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Home Study Dept. RE-4-55
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These top features assure Philco StarBright dealers of top sales . . . top profits in picture tube replacements. They mean sharpness, clarity, detail and over-all performance that give "You are There" realism.

Right in your neighborhood there are hundreds of TV set owners who want the new, fresh, vital picture that only a Philco StarBright 20/20 can provide. Now is the time to sell them . . . and the Philco StarBright 20/20 can be installed in practically any make TV.

Your customers want a quality picture—they know Philco—famous for quality the world over. Put the two together and you've started sales and profits rolling your way. Call your Philco Distributor today for complete details on this money making program.

PHILCO TUBES IMPROVE THE PERFORMANCE OF ANY TV OR RADIO RECEIVER

Star Bright 20/20

PICTURE TUBE

Backed by Powerful Profit Producing Promotion

Eye-catching, colorful store and direct mail pieces bring home the advantages of Philco StarBright 20/20—fast—for quick consumer action. Put this material to work for you.

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SHARE *and* PROFIT

OPPORTUNITY!

Service Dealers everywhere are going to make more money with Philco this year. Bonus dollars and profits are yours with *no* additional effort through one of Philco's greatest promotions. Call your Philco Distributor at once for complete details.

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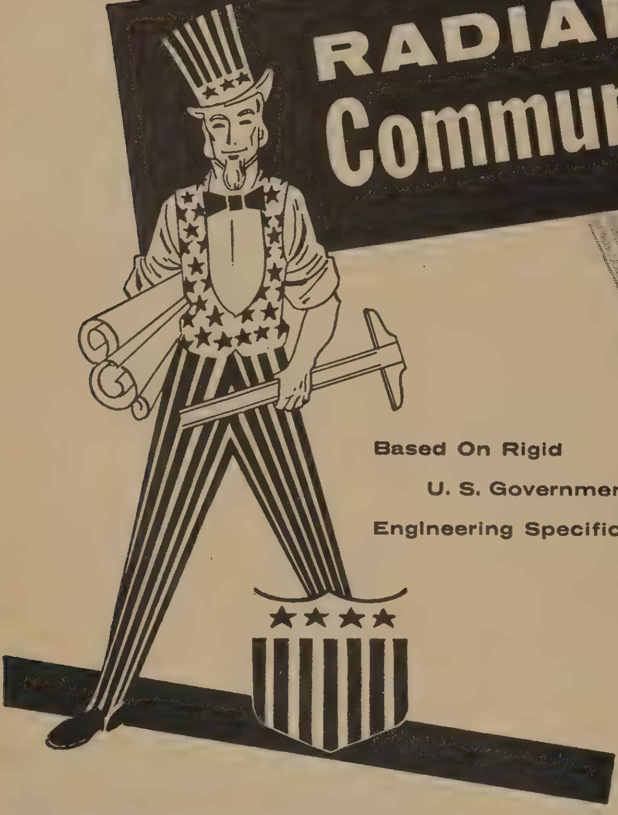
RADIART SEAL·VENT Communication Vibrators



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NOW... RADIART makes available to commercial users of communications equipment, a new line of vibrators based upon experience of producing over 2 million similar units to the exacting requirements of U.S. Signal Corps Specifications.

It's ready now!
The new 1955 Radiart Vibrator Replacement Guide

These Eight Types Offer Complete Replacement for ORIGINAL Communication Equipment:

Old No.	New No.
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★	**5721**
★	**5722**
5605	**5805**
5620	**5820**
5621	**5821**
5622	**5822**

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EICO CATALOG!
Tells you how to SAVE 50% on your test equipment costs!
EICO®
THE LARGEST MANUFACTURER OF ITS KIND IN THE WORLD
KITS
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THE INDUSTRY'S MOST COMPLETE LINE OF KITS & INSTRUMENTS
1/3 MILLION EICO INSTRUMENTS IN USE THE WORLD OVER—
SAVE 50%—BUILD 'EM IN ONE EVENING...THEY LAST A LIFETIME
the Exclusive EICO Make-Good
GUARANTEE
Each EICO Kit and Instrument is doubly guaranteed, by EICO and your jobber to contain only selected quality components. EICO guarantees to replace any component which might become defective in normal use if returned to the factory within 90 days of purchase
EICO guarantees all Kits assembled according to EICO's simplified instructions will operate as specified therein
EICO guarantees service and calibration of every EICO Kit and Instrument at the nominal charge as stated in the instructions
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KIT $44.95 WIRED $79.95
NEW! #470 7" PUSH-PULL OSCILLOSCOPE
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NEW! #232 PEAK-to-PEAK VTVM with DUAL-PURPOSE AC/DC UNI-PROBE (pat. pend.)
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VACUUM TUBE VOLTMETER #221
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KIT $34.95 WIRED $54.95
R-C BRIDGE & R-C-L COMPARATOR #950B
KIT $19.95 WIRED $29.95
MULTI-SIGNAL TRACER #145
KIT $19.95
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DELUXE RF SIGNAL GENERATOR #315
KIT $39.95 WIRED $59.95
6V & 12V BATTERY ELIMINATOR & CHARGER #1050
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NEW! #944 FLYBACK TRANSFORMER & YOKE TESTER
KIT $23.95
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KIT $19.95 WIRED $29.95
TV/FM SWEEP GENERATOR #360
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SMC—4.5MC CRYSTAL
$3.95 ea.
A PROBE FOR EVERY PURPOSE
EICO®
See the famous EICO Line at your jobber today
SEND FOR FREE CATALOG C-4
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Prices 5% higher on West Coast
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RADIO-ELECTRONICS

Hugo Gernsback, Editor

ATOMELECTRONICS IN 1980

... The new art will soon be a giant ...

SINCE the advent of the atomic age early in the 1940s, the wedding of atomics with electronics has blossomed into an important new art. This is but natural, because the electron is an integral part of the atom — neither can exist without the other. "Atoms for Peace" will not be an idle hope by 1980, twenty-five years hence — indeed, it may well be the greatest civilizing force humanity has ever experienced.

The reason for this is found in the tremendous energies locked up in the atom — a power that now is beginning to be set free for the emancipation of mankind.

We already have actual working prototypes of atomic batteries in use today — scientific toys, to be sure, just like Volta's battery of 1800. It, too, was a toy, but nevertheless the forerunner of the electrical age of the twentieth century.

The great difference between the two batteries is that the galvanic type tranforms chemical energy into electricity in comparatively small quantities, while the atomic type — due to its vastly greater inherent power — gives us atomic-generated electrical energy, not for a few puny hours, but for many years continuously.

We must be careful at this point to differentiate always between present-day atomic power plants and future ones of 1980. Today, we obtain atomic power in a roundabout manner, by using *only* the thermal or heat effects of the atomic reaction. We go back to the ancestral steam engine by heating a boiler with atomic energy and finally running an electric generator with it. As beautiful a twentieth-century anachronism as you will ever find!

The thermal reaction of the atomic pile is in reality an undesirable one from the energy viewpoint— and, indeed, the atomic engineer of the future will try to eliminate it as far as possible. The reverse is true today — we use the atom *only for heat purposes* and suppress its far greater energy — *the electromagnetic power* — by useless, massive shielding. It is precisely here that the great strides of the future will be made, and the atomic battery — predicted by the writer in 1945 — points the way. *The atomic energy of 1980 will be mostly electrical,* not thermal, except for specialized purposes where it will be more practical to use direct atomheat.

Automobiles, motorbikes, pistonless airplanes, locomotives, power plants, all will run on *directly* generated atomelectric energy. So will most portable tools and appliances, which will have a tiny inbuilt atomelectric power supply.

The same will be true of our radios and television receivers, none of which will depend upon the present-day electric house current.

Possibly the greatest boom of atomelectronics will come through new and highly perfected future semiconductors, intimately linked *directly* to the atom. We have already made laboratory and experimental models of atom-powered transistors; this is but a beginning, with revolutionary advances certain to follow in the not-too-distant future.

The greatest engineering development will come in the extensive simplification of most of our electronic instrumentation. Our radios and television sets by 1980 will bear little resemblance to present-day ones. They will in the main be tubeless and transformerless. Even the capacitors and resistors will be unrecognizable by today's standards. Much of the wiring will have disappeared: integral *self-components* will be directly fashioned into a homogeneous block. Hence, the present-day bugaboo of loose connections will largly fall by the wayside. This will then be the service technician's paradise.

Recent radio-astronomical research tends to show more and more that radio waves in free space are created atomelectronically. This means nothing less than *instrumentless transmitters.* Imagine an almost weightless yet powerful radio transmitter! Translate this into a mundane portable broadcasting unit the size of a matchbox, and you can visualize the great possibilities. The day will come when all of us will be able to carry a miniature compact dial phone in our pocket for instant communication with the entire world. A tiny buzzer will "ring you" via your pocket phone, no matter where you are, for instant, world-wide *personalized* communication.

Far more important than all this, however, will be the atomelectronic role in the coming great emancipation of the world's underprivileged and starved populations—a vast reservoir of potential communism.

We can visualize tens of thousands of special atomelectric farm tractors all over the world which do not require refueling for years. They can sow and reap automatically by means of modified computers and photocells, moving back and forward between special rows of markers which flag the photocells. These tractors will also furnish all the energy for even the largest farms, supplying them with light and power for every imaginable purpose.

One hundred thousand such tractors, opening new farmlands on the five continents, could do away with the ageless starvation threat and bring prosperity to every land under the sun.—*H. G.*

HORN-TYPE SPEAKER SYSTEMS

By GEORGE L. AUGSPURGER

Part I—Fundamentals of horn speakers; the folded horn; introduction to the corner horn

THE salesman pointed out enthusiastically that only with horn loading could a high-fidelity speaker system give true distortionless bass response. "Just listen to those low notes," he said. "That's the real thing. No more of that boomy jukebox bass."

All of which was common enough sales talk except that the man happened to be selling juke boxes.

Another demonstrator explained that his product used real Klipsch-licensed folded-horn construction. Said he, "We don't believe in the boomy resonant bass you get with bass-reflex systems." He pointed to a little cabinet about the size of a cigar box which sounded very much like a bass-reflex system. "Nowadays," he chortled, "anyone can afford genuine corner-horn reproduction with the 'Little Gargoyle' portable corner horn."

You may have recognized the scene as one of the recent audio fairs. Except for a few stubborn manufacturers who retained modified bass-reflex or R-J enclosures, it seemed that you were simply nowhere unless you had some sort of "four-dimensional reintegrated axis nonparallelepiped corner horn" to offer the panting audiophiles.

Horns have been used as integral parts of musical instruments for years. The horn in reverse, used as a somewhat obvious candid microphone, transmitting conversations to an eavesdropper in another chamber, was a plaything in the time of Leonardo da Vinci, and came down to us as the ear trumpet—the first hearing aid. When a sound-reproducing device was finally invented, it was inevitable that a horn would be used to amplify the delicate shudders of its tiny diaphragm. I say inevitable because at that time, prior to any sort of electronic audio equipment, the horn was the only known method of coupling a small vibrating reed or diaphragm to the surrounding air. And in that word "coupling" lies the whole secret of the horn.

Nowadays even the greenest audiophile knows that a horn is an acoustic coupling device similar to a transformer in electrical circuits. The bass response of a horn depends both upon its rate of flare and its mouth area. An exponential horn which doubles its cross-sectional area every foot is said to have a 60-cycle flare. If it doubles every 2 feet, its flare is said to be 30 cycles, and so forth. If the horn is mounted in a flat wall, the mouth diameter should be equal to at least one-quarter the wavelength of the lowest frequency to be reproduced. If the same horn is mounted at the intersection of two walls, the mouth area can be cut in half. Similarly, if mounted at the intersection of two walls and ceiling or floor, the mouth area can be reduced to one-quarter that of the flat wall model.

All these rules are derived mathematically in Olson's *Elements of Acoustical Engineering*, or one can use the optical analogy of Gately to construct the effective mouth diameter of a particular design as in Fig. 1. But this isn't the only space-saving trick handed us by the acoustic engineers. The horn need not be straight—it can be bent, folded, curled, split or tied in knots—à la Sousaphone. Furthermore, the cross-section need not be circular. The horn can be triangular, square, rectangular, hexagonal or shaped like an "F" slot. (The last configuration is especially good for snob-appeal installations.)

The various configurations possible and the basic design considerations behind them were covered in an article in the November, 1951, issue of *Audio Engineering*. In that article I made the point that, all other things being equal, a straight horn is preferable to a folded model. Since the publication of that manuscript there have been placed on the market, by actual count, over 30 folded, curled, twisted, knotted or kneaded exponential horns of various shapes and sizes. One straight horn has appeared. Of course, the argument of straight *versus* folded horns always resolves itself once the problem of size arises, since a full-sized straight horn is a monstrous affair.

The folded design isn't the only compromise made in the interests of expediency. All the configurations now on the market are built with the following assumptions being taken for granted:

1. The wave front in a horn is a plane surface perpendicular to the axis of the horn *for relatively small rates of flare.*

2. Bends or folds in themselves will not introduce objectionable distortion *as long as the cross-section is relatively small at that point.*

3. The horn is made of some fictional material which neither transmits nor absorbs any sound at all. (Don't laugh,

this statement is lifted right out of Olson!)

With these design axioms in mind let's take a look at what can be done with the basic exponential flare idea.

Straight exponential horn

With the exception of the familiar horn type tweeter, nobody makes a wide-range unit of this type, so the discussion is practically ended right here. A full-sized horn is shown in Fig. 2 in case you want to build one. Made of concrete block or some such material, this design will perform almost exactly according to theoretical expectations.

Folded horn

Here we begin to get into the region where good designs are often accidental. I don't mean to imply that a great deal of careful preliminary design and sweat are not included in the price of even the least expensive design. My point will become clear, however, if we take a look at a few such horns.

The Frazier-May horn (see photo) is a brand-new addition to the fraternity of folded horns. It is a square wooden variation (Fig. 3) of the re-entrant public-address horn. Naturally the Frazier-May is described as revolutionary and a completely new concept. (These are advertising terms that carry about the same semantic implications as "hello.")

The Frazier-May horn is built of three conic sections driven by an 8-inch cone speaker. The first fold bends around a double partition lined with Fiberglas. This gives a reasonable amount of acoustic insulation between the first two sections of the horn. But in the case of the second fold, a common piece of plywood is used between the terminating sections. It seems reasonable that, if this single barrier transmits any acoustic energy at all, the cabinet is no longer operating as a true horn. To aggravate this acoustic short circuit further, six wooden spacers fasten the two sections of the cabinet together. These spacers probably act just as the bridge in a piano, transmitting vibrations from the inner wall (where sound pressures are fairly high) to the outer shell which now acts as a sounding board in addition to its other function.

The mouth area of the Frazier-May is in the neighborhood of 225 square inches. Since the manufacturer claims a frequency range equal to that of a symphony orchestra, this implies that the horn will reproduce a 30-cycle bass fundamental. Obviously this does not jibe at all with my original rules for optimum mouth diameters, and yet the model 8-50 actually doesn't sound bad.

The paradox has already been explained in the statement that the unit is not operating as a true horn. It is partially a horn, partially a large vibrating sounding board, partially a tuned air column resonating at about

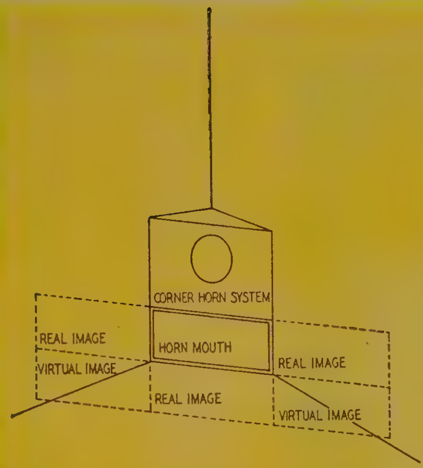


Fig. 1—Constructing effective mouth diameter by plotting reflected images.

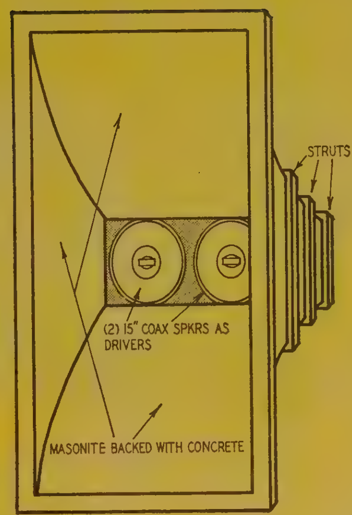


Fig. 2—The straight exponential horn.

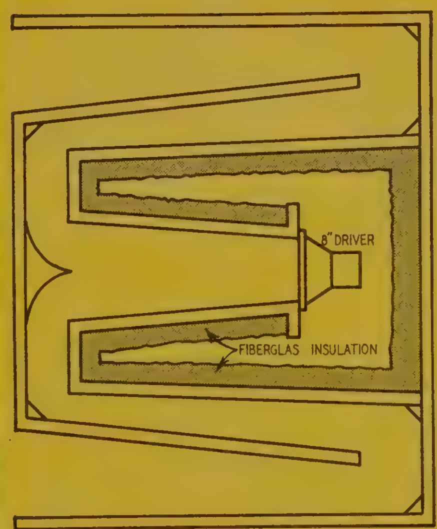


Fig. 3—Interior of Frazier-May horn.

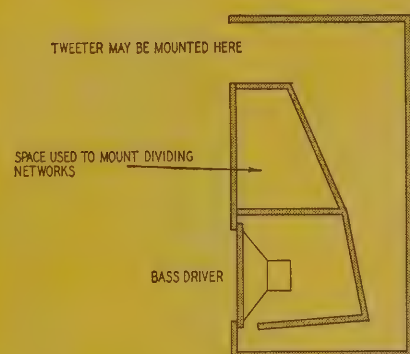


Fig. 4—The Jensen *Laboratory Standard*.

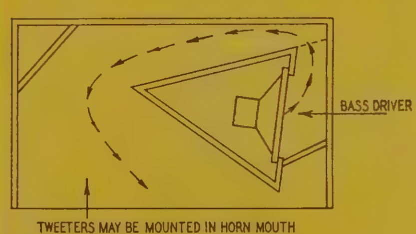


Fig. 5—The University *Classic*—horn may be mounted vertically or horizontally.

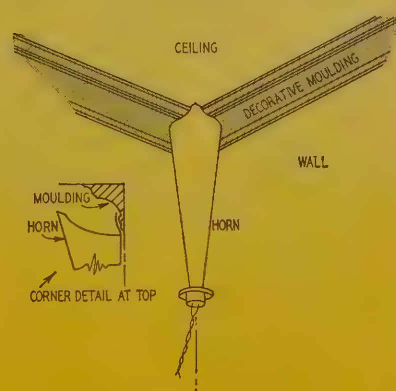
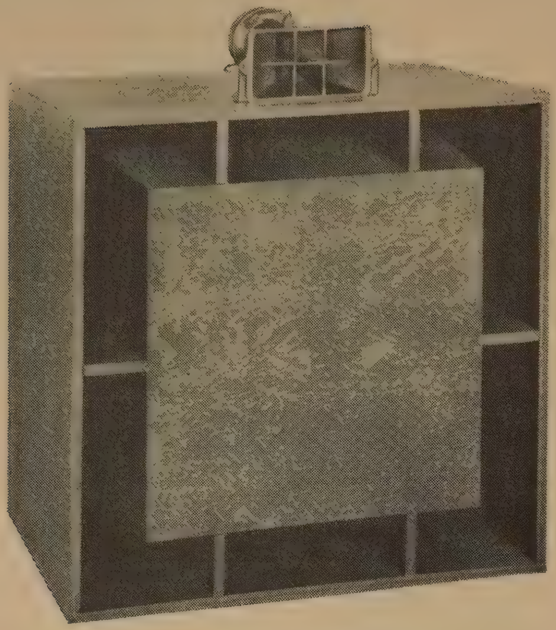
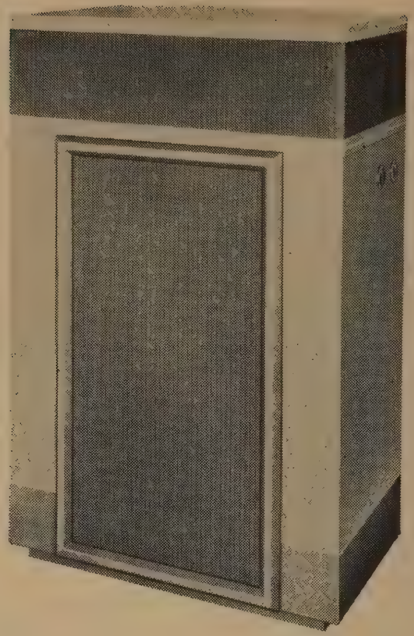


Fig. 6—Ephraim's portable corner horn.



The Frazier-May is a modified re-entrant horn.



Above is the Jensen *Laboratory Standard* horn.

80 cycles and partially a cluster of separated sound sources mutually coupled. The mutual-coupling principle is a feature its designers make no mention of. (It is discussed in the Permoflux *Diminuette* system described in the October, 1954, issue of RADIO-ELECTRONICS. Due to the mutual coupling effect the 8-50 has a virtual mouth area in all probability of somewhere around 400 square inches. If the wooden spacers were replaced by standoff bushings the mouth would become a radial-slot sound source and the bass efficiency would probably be increased. I'll talk about the radial slot later on, but to return to the Frazier-May—I may be sticking my neck out by making the guess that some designs are partly accidental, but I can't see any other way to explain the very passible performance of a unit which seems to violate the principles of good exponential horn design.

Another horn type system which achieves its results by departing from basic exponential design is the new Jensen *Laboratory Standard* model RS-100 (Fig. 4). The main difference in approach is that in this case the departure is a deliberate one, carefully calculated. The RS-100 is basically a vertical horn terminating in a horizontal slot mouth. In this case the mouth area, horn length, flare (Jensen uses the refinement of a hyperbolic-exponential formula) and driver cone resonance are all ingeniously juggled in such a way as to give genuine low-distortion response down to 35 cycles.

It is a source of personal satisfaction to me that the *Laboratory Standard* achieves its results in part from a horn which is curved rather than folded and which uses no partition common to two sections of the horn. A thorough analysis of the design of this really excellent speaker is found in the October, 1954, issue of *Audio* magazine. Since the Jensen is not only considerably more expensive, but seems to be more painstakingly designed than the Frazier-May, I wasn't surprised that to my ears it sounded a good deal more unobtrusive. (The word "unobtrusive," by the way, is rapidly becoming the definitely "all right" term to use in describing the performance of the very finest high-fidelity speaker systems.)

Of course, an exponential horn can be squashed into all sorts of configurations with varying degrees of success, depending generally on the degree to which factors other than true horn loading enhance or detract from the performance of the system. Fig. 5 shows the interior construction of the University *Classic*, representative of folded-horn design.

Almost all these systems, by the way, use horns for mid- and high-frequency sources as well as bass generation. Most of the high-frequency units are carefully, conventionally designed straight exponential units. The horn-type tweeter has become familiar to anyone who knows anything about hi-fi and I suppose that it was because of its very familiarity I forgot about it when I said that nobody made straight horns. All the basic assumptions of horn design are very nearly met in these small horns. The fine performance of the better tweeters indicates that the problem of size, rather than mere engineering conceit, is responsible for the lack of straight exponential bass horns.

Corner horn

There is some squabbling among audio bigwigs as to just who first thought of the idea of a corner horn. The basic concept is simple enough and immediately attractive. The solid angle formed by the intersection of two walls and floor in an ordinary room forms a conic horn of triangular cross-section. If an exponential horn can be built into the corner in such a way as to couple effectively a loudspeaker to the horn formed by the corner itself, a great saving in space with a corresponding increase in efficiency can be realized.

Audak claims the honor of thinking of this scheme for their own *Maxmillian Weil* and in the opposing camp Paul Klipsch is widely known as the originator of the hi-fi corner horn. However, a Frenchman named Ephraim probably was the first consciously to exploit the corner itself as a conic horn. Ephraim's idea (Fig. 6) was to use a headphone or a diaphragm type driver unit coupled to a conic horn which was then hung in a corner from the decorative molding that usually graced rooms of that period. Voila! . . . a small, portable, true corner-horn system. (On May 25, 1929, E. K. Sandeman filed a patent claim for a "Loud Speaker" that contained ". . . a sound generator located in a corner provided by three planes intersecting each other at right angles to form a solid angle into which the diaphragm discharges . . ." The patent, No. 1,984,550, was issued Dec. 18, 1934.—*Editor*)

Ephraim's patent, while not an exponential horn and definitely not high fidelity as we think of the term, can nevertheless be recognized as the true parent of such systems as the Brociner model 4 and the Lorenz sound corner. Klipsch, on the other hand, approached the concept a little differently and, because his design is much easier to adapt as a piece of furniture, almost all corner horns today are offshoots of the original Klipsch model K introduced in 1941.

In the next installment we will discuss the basic Klipsch design and the numerous commercial variations based on it.

TO BE CONTINUED

Improving Low-Priced Tape Recorders

Part I—Making a preliminary survey; improving the signal-noise ratio; installing new heads; cutting down the hum

By HERMAN BURSTEIN

WELL over 95% of what most people consider pleasurable music lies within the 50–9,500-cycle range. A tape recorder having an essentially flat response over this range at 7.5 i.p.s., no noticeable flutter, very low distortion and a very low noise level is an item of which no high-fidelity system need be ashamed. Yet, unlikely as it may seem, such a recorder can be had for less than $150 plus several hours of labor. This does not include a power amplifier.

Starting with a Pentron PMD-1, which consists of a transport mechanism and preamplifier (equipped with VU meter) in one case, I made changes resulting in a tape recorder that sounds excellent in comparison with machines costing two or three times as much. The same can be done with other inexpensive tape recorders.

The setup of Fig. 1 was used to plot frequency response and observe waveforms. The v.t.v.m., flat far beyond the audio range, was carefully observed during recording, and the oscillator, which has two outputs, was regulated

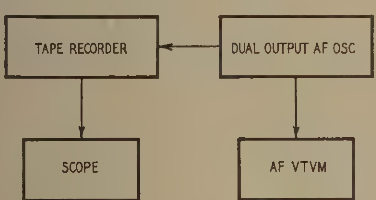


Fig. 1—Equipment setup for measuring a tape recorder's frequency response.

to maintain a 1-volt input to the recorder at all frequencies. Tests were made on Audiotape 1251 (regular) and 1861 (long playing) with no signficant differences observed between the two. Frequencies for testing were: between 30 and 100 cycles, 10 cycles apart; between 100 and 1,000 cycles, 100 cycles apart; between 1,000 and 12,000 cycles, 1,000 cycles apart.

To facilitate frequency identification on the oscilloscope during playback, a 50-cycle signal was inserted after 100, 500, 1,000 and 10,000 cycles.

The output of the tape recorder during playback was displayed on the oscilloscope, using a fine-ruled grid screen. A little practice, together with the 50-cycle benchmark, made frequency identification easy. Using 1 kc as a reference frequency, its amplitude was adjusted to fill exactly 20 vertical spaces on the oscilloscope screen. The relative value of all frequencies could then be read with an accuracy of better than 0.5 db. The v.t.v.m could have been used to measure output amplitude, but the oscilloscope had the advantage of providing frequency recognition as well as indicating distortion.

The Pentron PMD-1 basic tape recorder and the new Dynamu hi-fi recording head.

Taking the Pentron PMD-1 as it came, tests showed three areas for improvement:

1. *Smoothness of response.* Although the frequency range was acceptable—3 db down at 60 and 9,000 cycles—response was not smooth. Between approximately 2,000 and 5,000 cycles there was a gradual rise to a peak of about 4 or 5 db. This was confirmed by taping a good-quality LP record, playing back the tape simultaneously with the record and making rapid A-B comparisons between tape and record with a selector switch. The tape had appreciably more treble.

2. *Distortion.* When signals were recorded at the VU level recommended by the manufacturer, there was considerable distortion during playback of frequencies below 500 cycles, especially below 100 cycles. To reduce distortion to an acceptable point, it was necessary to record at levels producing an unsatisfactorily low signal-to-noise ratio.

3. *Signal-to-noise ratio.* It was possible to record the mid-range and treble frequencies at a level producing a tolerable signal-to-noise ratio—one associated with moderate-price tape recorders. However, the recorder was not really quiet in the sense associated with good audio equipment. Tape hiss, preamplifier hum, white noise and other noise were still objectionable at all but very low listening levels.

Before attempting to smooth and possibly extend frequency response I decided to attack the more important problems of distortion and signal-to-noise ratio.

Signal-to-noise ratio and distortion

With the record–playback head and VU meter circuit disconnected, the preamplifier (Fig. 2) was tested and found free of distortion. The PMD-1 has a fair amount of degenerative feedback in the form of unbypassed cathode resistors. An oscilloscope check showed no visible distortion in the range of 20 to 15,000 cycles.

However, with the VU meter circuit restored, there was distortion, particularly of frequencies below 1 kc. A 400-cycle signal recorded at any level was heard in playback with a great deal of harmonic content. Thus the lower notes of a piano had a tinny ring.

The following steps were taken to improve the signal-to-noise ratio and at the same time reduce distortion below audibility:

1. *Substitution of Dynamu heads.* At the 1954 Audio Fair in New York City I saw a demonstration of the recently marketed Dynamu record–playback head (made by Dynamu Magnetronics Corp., Minneapolis, Minn.) This miniature head (see photo) provides professional performance in terms of frequency range, distortion, output level, smoothness of low-frequency response, hum pickup and tape hiss.

The head's gap is only .00015 inch wide, compared with widths of .00025 to .0005 inch in other heads, so that under suitable conditions it potentially has a high-frequency playback limit of 25 kc at 7.5 i.p.s. Furthermore, a resonant frequency as high as 85 kc, depending on lead length, enables the head to be most efficient in playback at high frequencies, the ones most subject to attenuation. Not only is the gap extremely narrow, but also extremely straight; the manufacturer claims a deviation of no more than two wavelengths of light from top to bottom. Linearity and narrowness of gap provide a high degree of resolution in reproducing information on tape. They reduce intermodulation distortion, high-frequency losses due to azimuth misalignment, and distortion and losses produced by flutter and weaving of the tape as it passes the head.

Instead of a dielectric shim, the gap is occupied by electrolytically deposited copper that reduces eddy losses. Miniaturization of the head decreases hum pickup and enables it to perform well in playback at low frequencies, especially those below 50 cycles, where flux changes are very slow. Because it is small, the head is close to the tape and relatively efficient in the low range. Low-frequency response is also extended because the coil is wound very close to the core, improving the coupling between the two.

To investigate the head's performance, I purchased Dynamu kit D801, including erase head, which had just become available for the Pentron 9T3C. (The transport mechanism of the 9T3C and PMD-1 are substantially the same.) Similar Dynamu kits are available for many of the popular tape recorders.

Precise positioning of the heads is necessary, requiring a ruler accurate to 1/64 inch. The heads are half-track and must be mounted with respect to the tape and each other so that they function on the lower track of the tape. Moreover, the height of the tape guides should be set to run tape to the reels without scraping the top or bottom of the reels. The heads were therefore mounted slowly and carefully.

To replace the original Pentron heads it was necessary to remove the black *plastic* cover over them. This procedure is tricky in the case of the PMD-1. First, take off the two oblong knobs attached to the idle-run and wind–re-wind control shafts; then unscrew the hexagonal nuts on these shafts, enabling the black *metal* cover over the shafts to come off. Second, remove the five perimeter screws on the copper plate of the transport mechanism. Third, remove the feed and takeup spindles by taking off the pulleys attached to them beneath the chassis of the transport mechanism. These steps permit removing the copper plate on top of the transport, and attached to the plate is the *plastic* cover that is over the tape recorder heads.

Connecting the shield wire of the record–playback head to ground, as instructed, produced a large amount of hum pickup. However, when the shield wire was left floating, satisfactory results were obtained. Connecting the red lead of the record–playback head to ground gave minimum hum pickup. Azimuth alignment was at first performed by eye, although, as described in the section on frequency response, an accurate alignment was later made. For proper contact between tape and heads, the felt pressure pads were detached, carefully trimmed to fit the new heads, and reglued.

The Dynamu heads call for an oscil-

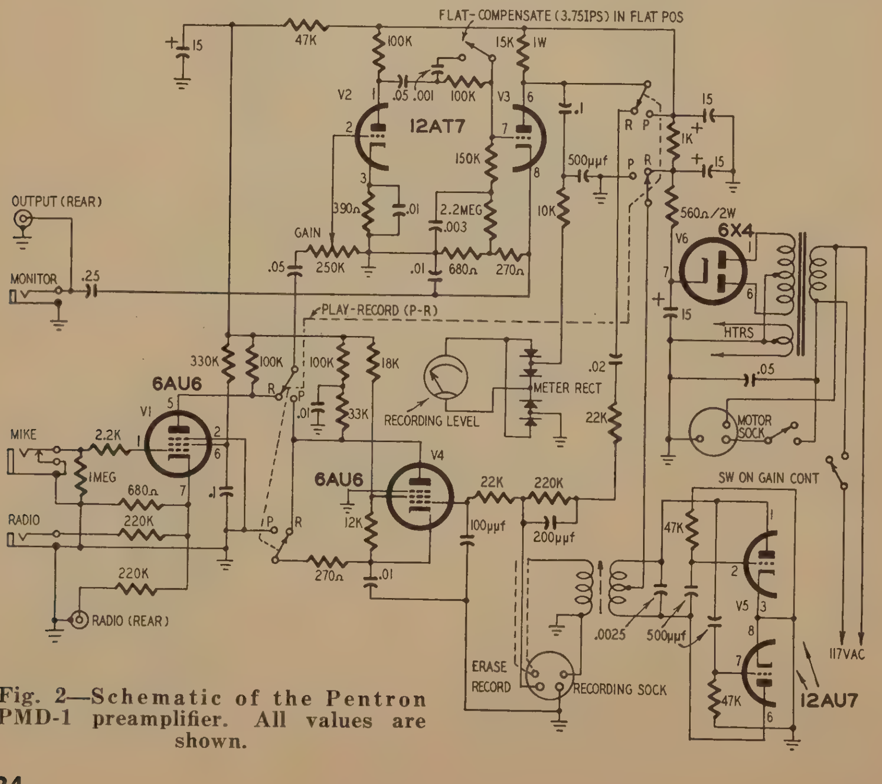


Fig. 2—Schematic of the Pentron PMD-1 preamplifier. All values are shown.

lator frequency of 60 to 100 kc. A frequency of 96 kc was obtained by replacing the .0025-μf capacitor across the primary of the oscillator coil with a .001-μf ceramic capacitor and turning the oscillator-coil slug nearly all the way out. A change in wiring was required to supply the correct amounts of bias current to the Dynamu erase and record–playback heads. Fig. 2 shows that the original Pentron circuit feeds bias current to the record–play-

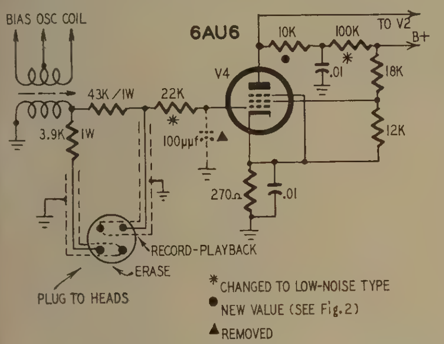


Fig. 3—Schematic of the first stage of the modified Pentron playback circuit.

back head via the capacitance between the hot lead to this head and that to the erase head. As shown in Fig. 3, separate coaxial cables were run to the two heads, and the correct amount of current to each was supplied through limiting resistors. To minimize capacitance across the record head, Belden 8401 cable, with a capacitance of only 25 $\mu\mu$f per foot, was used to feed signals and bias current from the preamplifier to the record–playback head.

Changes in bias current through the erase head have a significant effect upon current through the record–playback head. Since the record–playback head current is the more critical, the limiting resistor for the erase head was determined first. The Dynamu erase head should be fed a maximum of 13 ma. A 3,900-ohm 1-watt resistor provided this current. Dynamu recommends a bias of 0.4 to 0.8 ma for the record–playback head. I decided to use the higher figure because distortion decreases with increased bias current. Therefore, a 43,000-ohm limiting resistor was used to supply bias to the record head. To measure bias current to the erase head, a 100-ohm resistor was inserted between the ground lead of the head and ground; the voltage across it was read, and the current calculated. Record–playback head current was similarly calculated by the voltage across a 1,000-ohm resistor. Voltages were read on a high-gain wide-band oscilloscope (flat to about 500 kc), calibrated with accurate voltages from a tube checker.

A preliminary check of the Pentron's performance with the new heads was very pleasing. Program music and speech could be recorded with peaks at about zero on the Pentron's VU meter, whereas previously it had been necessary to keep peaks at about -10 for the same degree of distortion. A tape recorded at 1 kc with the original Pentron head was played back with the Dynamu head and gave about 6 db more output. Moreover, the Dynamu head produced significantly less hum and tape hiss.

2. *Modification of VU circuit.* I considered either doing without the VU meter or substituting a 6E5 or similar electron-ray indicator to eliminate the distortion caused by loading the VU circuit directly onto the audio signal. However, the Pentron's meter together with the meter rectifier has sufficient bandwidth to be very useful—about 3 db down at 50 and 10,000 cycles. Therefore, I decided to isolate the VU circuit from the audio signal by adding a VU amplifier stage (Fig. 4).

A 6BH6 was selected because it is miniature (the PMD-1 chassis is crowded), inexpensive, and draws only 0.15 ampere filament current. Adequate room to mount a seven-pin socket was found between the 6X4 rectifier and the 6AU6 first record stage.

The values in Fig. 4 are approximately such that when program transients read 0 on the VU meter, the actual transient level is about 6 to 8 db above 0. This is because the meter, a mechanical device, cannot fully follow transients. Tape tests showed that

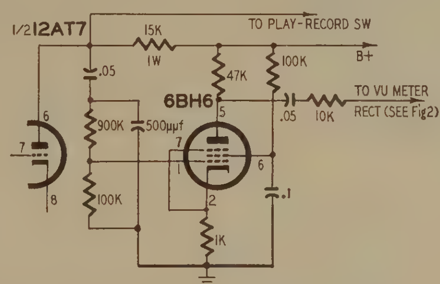


Fig. 4—Amplifier stage for VU meter.

most frequencies could be recorded with negligible distortion at levels 5 to 8 db above 0 on the VU meter. The record stage was monitored by an oscilloscope (the Pentron PMD-1 provides a monitoring jack on the panel), calibrated to read 20 spaces on a grid screen when a 400-cycle signal was fed in at a level 6 db above 0 on the VU meter. Then a live FM program was fed to the tape recorder. Generally when transients reached 0 to 2 db above the calibrated level on the oscilloscope, the VU meter hit about 0.

Professional standards call for the VU meter to have a safety factor of 10 db with respect to transients. In other words, when a steady sine wave of 400 cycles is fed to the record head at a level 10 db below the level which produces maximum allowable distortion, the VU meter should read 0. In practice, the writer and others have found that a safety factor of about 6 db is satisfactory, if judgment is used. For example, in recording material, such as piano music, with very sharp transients, peaks should not exceed -2 or -4 on the meter.

If a somewhat different calibration of the VU meter is desired, moderate changes in the 900,000-ohm resistor leading to the grid of the 6BH6 would provide the required difference of a few db in meter reading.

3. *Low-noise resistors.* The plate load and grid resistors of the first stage tubes were replaced by Aerovox type CP½ Carbofilm low-noise precision resistors (Figs. 3, 5). Also, the 47,000-ohm grid resistors of the push-pull bias oscillator (Fig. 2), which uses a 12AU7,

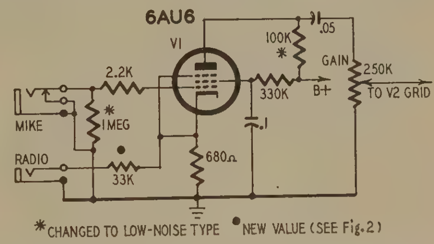


Fig. 5—Schematic of the first stage of the modified Pentron record circuit.

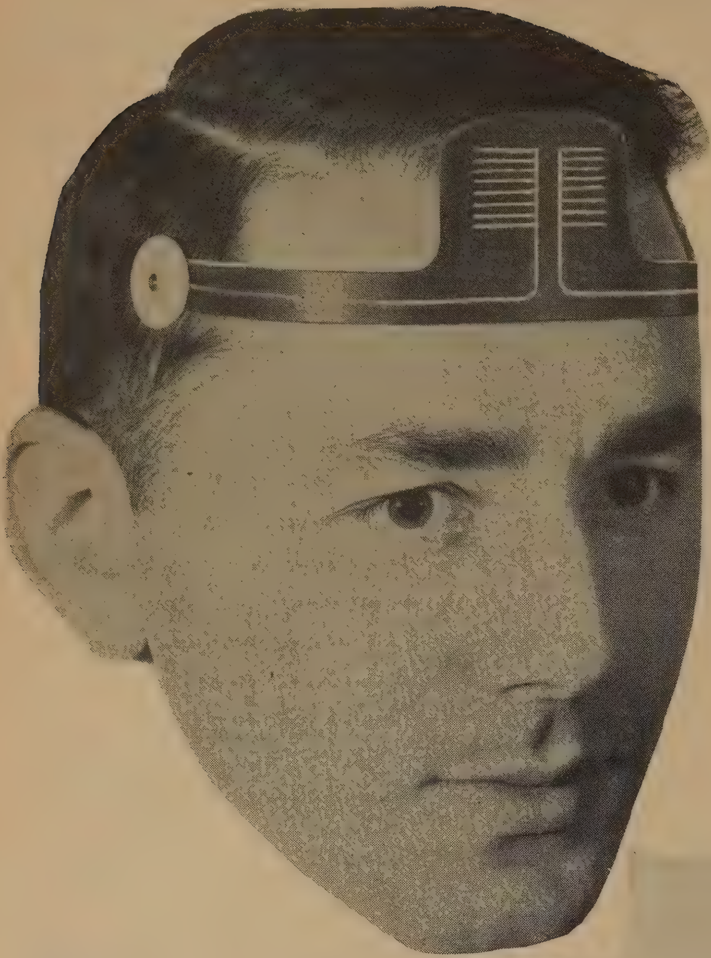
were replaced by Aerovox low-noise resistors. Altogether, six resistors were replaced, resulting in a considerable reduction of white noise. The resistors are available in values within 10% or less of the Pentron design, so that there was no significant change in performance other than noise reduction.

I experimented with the British Z729 pentode, which has characteristics similar to those of a 6AU6, in the attempt to reduce white noise and hum in the first playback stage. Although the Z729 is a nine-pin tube, only seven pins are used. I made an adapter from a seven- and a nine-pin socket and pins fashioned from internal elements of several old and otherwise worthless tubes. It was wired so that Z729 could be inserted via the adapter into a socket wired for a 6AU6. The Z729 produced perceptibly less white noise than the 6AU6; also somewhat less hum. However, the Z729 had about 5 db less gain, so that its initial advantage of less noise was virtually cancelled because the Z729 or 6AU6 is used before the volume control. Consequently the 6AU6 was retained in the Pentron circuit.

4. *Hum reduction.* While the preamplifier of the Pentron PMD-1 is good as to hum level, I found that a worthwhile improvement could be made by adding a 60-μf 450-volt capacitor to the filter circuit at the junction of the 1,000- and 560-ohm resistors (Fig. 2). It was mounted on the small chassis by strapping it to one of the original filter capacitors with a generous amount of tape.

A further attempt to reduce hum was made by disconnecting the center tap of the filament supply from ground and connecting it at a potential of about 35 volts d.c. Although hum was lowered slightly, a frying noise was introduced. Therefore the attempt was abandoned and the center tap restored to ground. However, in the case of other recorders this hum-reducing method might be more successful.

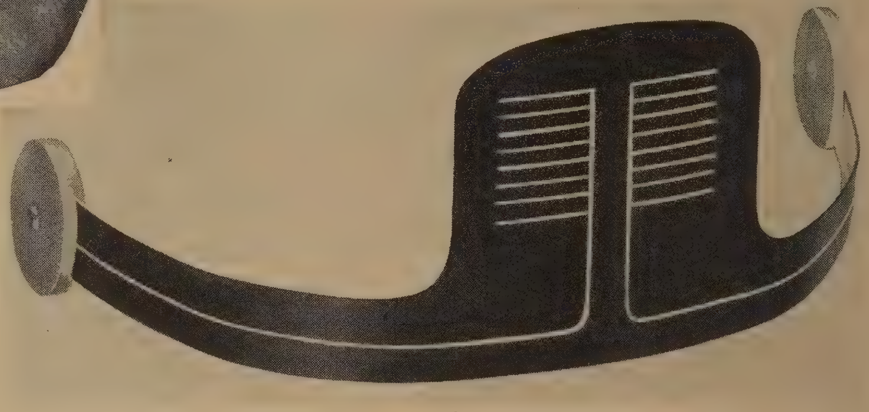
TO BE CONTINUED



SILENT SOUND

This revolutionary new advance in high-fidelity reception may prove as important as the invention of the telephone receiver

By MOHAMMED ULYSSES FIPS, I. R. E.*



The printed circuit submicrowave antenna and the templepieces.

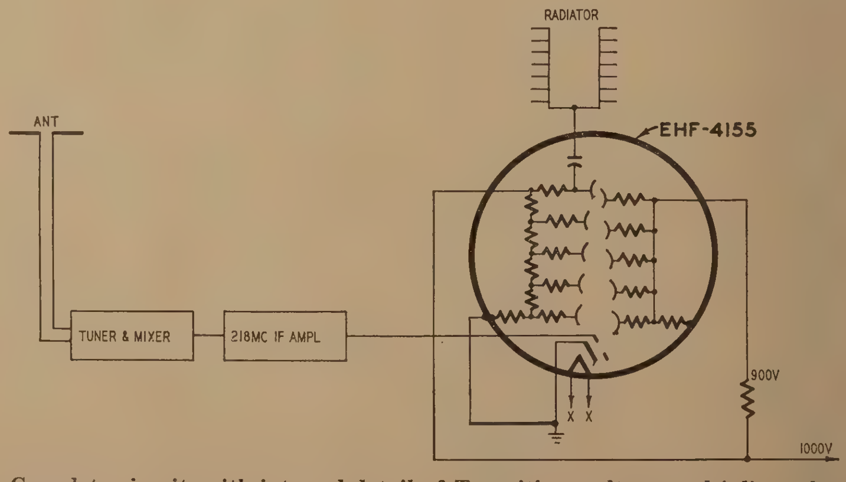
THE other day the big boss called me into his sanctum after lunch. He was smoking one of his eight-inch Havana cigars, after an evidently satisfactory lunch. I noted this immediately because he wasn't scowling, as is his usual custom. Indeed, much to my astonishment, he was in an expansive mood, with a broad smile on his unplowed, rough countenance.

"Fips, my boy," he began his lecture, "*sound*, the way we work it today, is an anachronism. We haven't invented a new thing in acoustics in thirty years! Then we added insult to injury by taking on high fidelity—I call it *hi-fi*ddlesticks! Hi-fi indeed—*for whom?* Less than half the population can hear above 10,000 cycles. Once you reach 35, your hearing becomes progressively worse. Only the very young hear well, and they are too young to appreciate good music. So what!?!

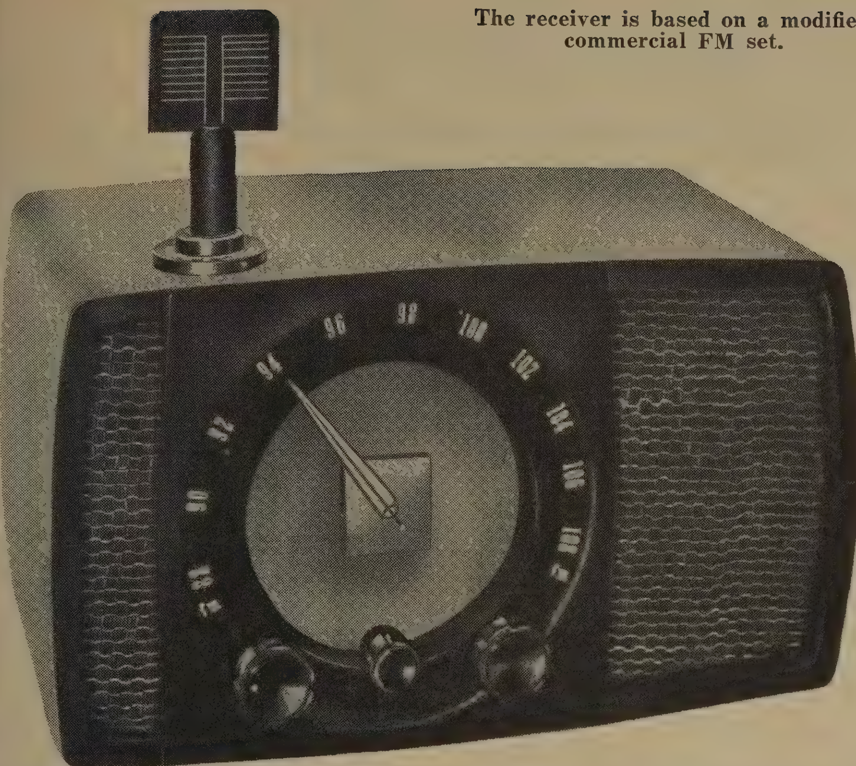
"Here we knock ourselves silly with expensive records and equipment, when half of the population doesn't get a thing out of them. It's like sending the inhabitants of a town to a technicolor movie *if half of them are color blind!* What good is that, I ask you?

"Now let's start at the beginning of broadcasting. What do we do? Do we broadcast audio sound? Of course not. We take the low audible sound and transform it into high-frequency elec-

*Institute Radiation Engineers



Complete circuit, with internal detail of Transitime voltage multiplier tube.



The receiver is based on a modified commercial FM set.

TYPE OF VIBRATION OR RADIATION	NUMBER OF VIBRATIONS (CYCLES) PER SECOND
Electric and sound	
Subsonic	Under 20
Power distribution and transmission	25 to 500
Audio (sound)	20 to 20,000
Ultrasonic (sound)	20,000 to indefinite
Radio	
Fixed, maritime, mobile, radio-navigation	10,000 to 150,000
Broadcasting, sea and air radio-navigation, mobile, safety	150,000 to 535,000
Broadcasting	535,000 to 1,605,000
Industrial, safety, government, international broadcast, mobile, fixed, scientific, medical	1,605,000 to 54 million
Broadcasting (television)	54 to 72 million
Mobile	72 to 76 million
Broadcasting (television)	76 to 88 million
Broadcasting (FM)	88 to 108 million
Air radio-navigation, mobile	108 to 132 million
Government, amateur, fixed, mobile, safety	132 to 174 million
Broadcasting (television)	174 to 216 million
Fixed, mobile, government, amateur, radio-navigation	216 to 460 million
Citizens radio band	460 to 470 million
Broadcasting (u.h.f. TV)	470 to 890 million
Broadcasting, government, radio-navigation, amateur, fixed, mobile	890 to 1,300 million
Fixed, mobile, radio-navigation, amateur, industrial, scientific, commercial communications, etc.	1,300 to 30,000 million
Experimental and amateur	30,000 to 100,000 million
Millimeter waves, quasi-radio frequencies	100,000 to 1,000,000 million
Infra-red, light, X-rays	
Quasi-infra-red	1,000,000 to 10,000,000 million
Infra-red, radiant heat	10,000,000 to 400,000,000 million
Visible light	400,000,000 to 800,000,000 million
Ultra-violet light	800,000,000 to 50,000,000,000 million
Soft X-rays	50,000,000,000 to 100,000,000,000 million
Industrial X-rays	100,000,000,000 to 10,000,000,000,000 million
Hard X-rays, industrial X-rays	10,000,000,000,000 to 100,000,000,000,000 million
X-rays, unexplored region	Above 100,000,000,000,000,000,000

tric currents—radio waves. These we now send into space from our transmitter aerials at frequencies from 550 kilocycles to 108 megacycles (for FM).

"In our homes, the aerials of our receivers intercept these radio waves; we retransform them down into audio currents and feed these into loudspeakers—and we *finally* hear the music or sounds in our ears. About as intelligent and roundabout an idea as scratching your left cheek with your right foot!

"Why do we need audio currents at all? Yes, I know—you will tell me that we have no suitable organ to intercept and *hear* radio waves. I know that too, but listen:

"We know that the human brain is an electric generator. Scientists have proven this with the *electroencephalograph* that records the output of the brain, which in turn generates electrical current day in and out. But just as an electric generator can be reversed and become a motor, so the animal brain can also be reversed under certain conditions and become a receiver, i.e., a motor, for electromagnetic waves. *Example:* carrier pigeons, when flying near a powerful broadcast station, can no longer orient themselves. They become confused by the action of the radio waves on their brains. All this is well authenticated.

"Evidently, there IS a way to reach the brain *directly* with radio or similar waves, so let's hop to it and eliminate the archaic sound waves of our prehistoric past—at least as far as our almost useless ears are concerned. Let's be modern and really enjoy music that IS music, from 16 to 32,768 cycles—THE ENTIRE RANGE, not just a pitiful 25% of it! And that, Fips, will be your job for the next three months! Get busy. I want results, less any and all alibis!"

With that the boss pushed one of his Havanas into the middle of my face and simultaneously whacked me on the back and out of his office.

Let's draw a merciful three months' curtain over the intervening laboratory scenery.

After some research, I decided to *eliminate all audio circuits* from a specially designed FM radio receiver, and instead of stepping the radio-frequency output *down,* I stepped it UP.

I had reasons to believe that, if there was a solution, it would be found in the little-known and almost completely unexplored region of the electromagnetic spectrum which is found between the radio and television region and the infra-red frequencies. See chart, next column. My figures showed that pigeon brains probably responded to the broadcast waves in a peculiar manner *through their wings, which acted as effective aerials while in flight.* The beating wings modulated, or rather polarized, the radio-frequency waves emanating from the broadcast station. But it was also known that the pigeons were never affected, say, a mile away from the station. Why?

The simple answer: HEAT! Close to the station, the energy (watt) output runs very high. So here we have a high-frequency radio effect PLUS a simultaneous infra-red-frequency effect. *The two added together affect the animal brain,* as predicted in my calculations.

Intensive tests soon confirmed the fact that at a critical point somewhat above 1,000,000 megacycles, there was a narrow band where sounds of all types could be "heard," NOT through the auditory nerve, but DIRECTLY through the consciousness of the brain.

I quickly proved this by bringing music to people who had been born deaf and those whose auditory nerves had been destroyed.

How does this silent music "sound"? It is quite indescribable! How would you describe a scent? The music and other sounds have a rather eerie effect—something quite ethereal—*that fills and permeates your entire consciousness.* And the experience of listening to sounds above 30,000 cycles is magical and breathtaking—at times it makes you actually shiver with delight when the music ascends into the fantastically high reaches never before sensed by mortal man. Such music, so far, is indeed rare—obtainable from only the best FM stations.

Truly, humanity will experience new and astounding thrills and pleasures, once silent sound is widely introduced to the world.

For important patent reasons, I naturally cannot divulge all the technical data of silent sound at this time. For this reason I will give only an outline of the new development.

The circuit diagram, page 36, shows the elements of the silent sound, to be known as S.S. system. It will be noted that it is an FM receiver which has no audio but an *extra-high-radio-frequency amplifier*—e.h.f. Instead of the usual speaker, the S.S. set has a special e.h.f. *radiator,* a peculiar type of antenna which radiates frequencies above 1,000,000 (one million) megacycles. This radiator is shown in the photograph, page 37. It is only 1 inch high.

The problem is, of course, how to produce the extra high frequencies. I solved it first by employing an Infradyne (recently called Summadyne) circuit, a superheterodyne which uses the sum instead of the difference frequency of the received signal and local oscillator. Thus the signal supplied to the e.h.f. amplifier was at 218 mc instead of the standard 10.7-mc i.f.

The signals were applied to the control element of the Transitime tube, a voltage and frequency multiplier that operates on the *transit-time* principle. It is well known that microwaves can be amplified by ordinary tubes if the frequency is so chosen that the *transit time* of the electrons results in their being in phase at each of the tube elements. The 10 anodes of the Transitime tube are arranged at evenly *decreasing* distances from each other, to take advantage of this principle.

The distance between the first two plates is selected to favor a low—and therefore strong—harmonic of the input signal. The plates are too close together to accommodate the fundamental and a few of the lowest harmonics, which are suppressed as a waveguide suppresses a wave below its cutoff frequency. The amplification at the pass frequency is 50 to 100, depending on voltage, and is due to *secondary emission* of electrons from the plate. Higher harmonics are passed in the same proportional strength as in the unamplified signal.

The distance between the second and third plates accepts a harmonic of the frequency amplified by the first two, and so on, each path between plates suppressing the former fundamental and producing a new and higher fundamental and harmonics. Since harmonics are always much weaker than the fundamental, the greater part of the tube's amplification capabilities are used restoring that difference, but there is a continual gain of amplitude through the tube.

The 1,000,000-mc signal at the last plate is radiated by a system tuned to the correct frequency by means of printed-circuit techniques. The antenna is a thin conductive layer, the *thickness* of which is a half-wave at 1,000,000 mc. The shape and other dimensions of the antenna are not important and were chosen in this case to make the antenna slightly directional, increasing the forward range.

How does the human brain receive these high frequencies? Through a distinctive type of headband illustrated at top of page 36. The headband is made of a special high insulating new plastic called *Metavynol.* It is thus not affected by the perspiration of the forehead. Note that the receiving antenna is in the center. *It is appliquéed—a printed circuit.* Two metal contact discs go over the temples; the discs in turn are connected by printed circuit with the tiny antenna. The contact discs are made of a recently invented highly porous metalloid foam. It heats up to about 101° F. under the impact of the e.h.f. waves. *These waves are now conducted to the sound perception center in the interior of the brain,* making S.S. reception possible.

It is in the metalloid foam that the transmissions are changed from FM to AM. The center frequency of the e.h.f. waves is the resonant frequency of the molecules of this substance. Any deviation from the center frequency due to modulation affects the amplitude of their vibration and hence the strength of the signal sent to the brain. Incidentally, the signal is transmitted along the headband to the templesets by the principle of the G-line, the waves being imprisoned in the thickness of the printed line and reflected back by each of the boundary surfaces.

The S.S. radio set is tuned just as is any regulation set, through a station selector; thus one can select any desired channel. Good reception usually can be effected up to about 30 to 40 feet from the radio set antenna. *The e.h.f. waves are stopped by walls or ceilings,* thus neighboring sets cannot interfere with each other.

Naturally *people in the room not wearing the special headbands do not hear a sound,* a special blessing of the S.S. system.

Further details must be withheld until next year in our issue to be published

APRIL 1

EDUCATIONAL HOBBY KIT

With the aid of a new *Electronics Hobby Kit* now on the market, it won't be long before children interested in this field will be performing experiments that will provide most of the answers they seek. The kit was prepared by RCA in collaboration with the Encyclopaedia Britannica and the Museum of Science and Industry.

Working with the kit, youngsters start with experiments in static electricity and batteries. Additional experiments involve making an electromagnet, experimenting with capacitors, understanding the function of electronic tubes, learning the Morse code. Advanced experiments include the construction of a simple low-powered radio transmitter and a one- or two- tube radio receiver.

The kit, designed for ages 8 to 18, is being distributed by Central Scientific Co., Chicago, and retails at $29.95.

FOR GOLDEN EARS ONLY

The Hartley 215 speaker and the Boffle; Altec 303C tuner; new records review

By MONITOR

ONE of the more remarkable personalities in the high fidelity field is Mr. H. A. Hartley. And my tests on his 215 speakers—which are very unconventional in design—and *Boffle* indicate that his products are equally remarkable. Mr. Hartley makes the startling claim that the 215's are nonresonant within the audio range. So far as I can determine this claim is true! I could find no resonance anywhere in the range above 20 cycles, the bottom of my generator.

Mr. Hartley also claims a response of from 20 to 20,000 cycles. Since I do not have an anechoic chamber and a precisely calibrated mike, my tests cannot be considered conclusive. However, for what it's worth I report that in the *Boffle* the pair of 215 speakers produced an excellent response down to 40 cycles and continued to give audible reproduction of fundamental (with very little doubling) for some distance below 30 cycles. I consider it very likely that in a suitable horn or larger infinite baffle, the response would continue down to 20 cycles. On the high end the response goes easily to 17,000 cycles and may extend beyond this with some slope to 20,000.

I have pointed out repeatedly that personal taste and preference must be taken into account in listening tests for loudspeakers. Like Mr. Hartley, I have always preferred nonresonant speaker systems and have gone to a great deal of trouble to approximate nonresonance in my own. I am, therefore, thoroughly accustomed to the sound of such a system and, naturally, prefer it to resonant or even horn systems.

In any case, I like the sound produced by the 215 speakers very much indeed. The transient response is remarkable; the whole range is covered as smoothly as a piece of chrome-plated metal with light oil. Especially notable is the fact that although the treble response at the extreme end is flatter than with most speaker systems, the reproduction is not at all shrill. The bass is outstandingly natural and the bass definition exceptional. People accustomed to the more accentuated bass of resonant enclosures and speakers will no doubt feel at first hearing that it is short on bass. I consider the combination at least as good as anything I've heard (short of theatre type installations). Achieving all this in an enclosure only 30 inches high, 18 inches wide and 17 inches deep is a noteworthy achievement.

The *Boffle* is by no means as funny as its name. In fact, for my money, the principle is nothing short of a stroke of genius. Mr. Hartley's problem was to provide in very compact form an infinite baffle free of internal resonance. To provide infinite baffling the rear wave has to be suppressed or prevented from reaching the front wave and producing out-of-phase cancellation at low frequencies. But when one uses a small box to accomplish this, the stiffness of the enclosed air produces resonance at some point between 20 and 200 cycles, depending on the size of the box.

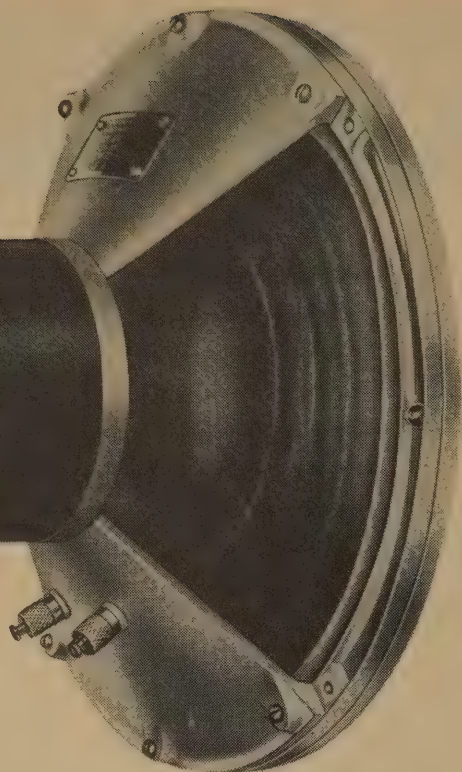
Mr. Hartley's solution is so simple that at first it reduces one to speechlesness. Instead of using a solid material for the back, Mr. Hartley uses some sort of loosily stretched sound-absorbing burlap and fiber material nearly one inch thick. This provides a very loose back which prevents compacting within the enclosure and therefore avoids resonance. In addition, the enclosure has seven layers of felt, each separated by about 2 inches and forming an acoustic filter that absorbs almost all the rear wave. Thus, only a small fraction escapes to meet the front wave and cancel it. In this way he achieves both infinite baffling and nonresonance with incredible simplicity and cheapness. The principle is widely applicable and experimenters might well try using it.

There is a price to pay for everything and the Hartley system does not achieve its fine performance without some sacrifice, namely somewhat lower efficiency. This is because the rear wave is wasted instead of being used to reinforce the front wave as in reflex and horn-loaded speakers, and neither the speaker nor enclosure is resonant. In the two-speaker combination this loss is almost made up by the increased efficiency due to mutual coupling of the two radiators; in the four-speaker combination the efficiency is about average. More bass boost and power output will be needed for the simpler Hartley combinations, but the loss of efficiency does not exceed 6 db in the case of the single speaker and is far less in the larger combinations. No modern high-fidelity amplifier should have any trouble supplying plenty of undistorted drive for any home-listening purpose.

I obtained permission to remove the speakers and their mounting board and to install the combination in my wall-type infinite baffle. As I suspected the two Hartley speakers produce a really superb sound in a wall mount. The bass extends to 20 cycles, though the slope is fairly severe below 30 cycles. Given a good bass boost (and the Hartleys can take it smoothly) the quality is extremely real. I would judge that a single Hartley in a closet would be very pleasing for small-apartment use, and a battery of four ought to provide really spectacular sound.

Altec 303C tuner

The latest in the series of Altec Lansing tuners is a more sensitive refinement on a now well proven design. It uses two independent tuners for AM and FM reception. The AM portion is entirely adequate though it does not pretend to offer extreme sensitivity. the i.f. bandwidth provides an excellent compromise between adequate selectivity and good audio quality. The tone quality is good for AM; interchannel beat-note and monkey-chatter interference is low enough not to be annoying. It will provide adequate reception in most locations with the simplest antenna—even the FM antenna. Adding an outdoor antenna can extend the



Side view of the Hartley 215 speaker. Unit is nonresonant through audio range.

range greatly where more sensitivity is necessary.

The FM portion is excellent in all respects. A cascode r.f. stage, two i.f. stages, one limiter and a ratio detector result in very good sensitivity—about 4 microvolts for 40 db of quieting. In my location this was sufficient to provide noisefree reception on all but one of the available high-fidelity stations, including two some 140 airline miles distant. A third station in the same city was still somewhat in the noise. The sensitivity would be higher if a.v.c.

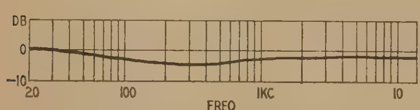


Fig. 1—Response of the audio channel.

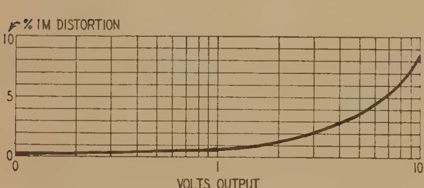


Fig. 2—IM distortion characteristic.

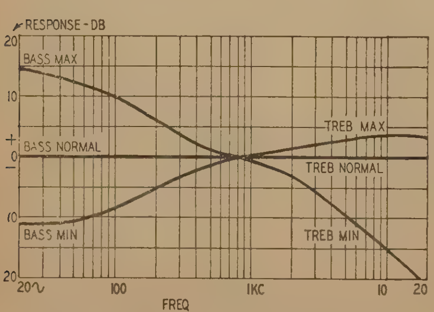


Fig. 3—The bass and treble response.

were not applied to the r.f. and first i.f. stage. However, the a.v.c. is good insurance against the phase distortion which often occurs through overloading on strong local stations. The passband appears to be close to 200 kc at 6 db down. The distortion is very pleasantly low.

The a.f.c. can be disabled by a function selector switch; however, it is easy to tune a weak station adjacent to a strong one with the a.f.c. on. An "eye" indicator permits accurate tuning and the receiver is as easy to tune on FM and AM.

The audio control portion is completely satisfactory. There are two jacks on the back for additional inputs —a magnetic pickup and a higher-level input such as a tape recorder or a crystal or ceramic pickup. The input in use is indicated on the dial. The audio channel is fairly flat from 20 to 20,000 cycles (Fig. 1). The slight rise in the bass is probably due to the fact that the bass control was not precisely neutral. This curve was taken with the generator applied to the spare (high-level) input channel and does not include the phono preamp. The IM distortion is below 2% (Fig. 2) for all levels of output less than 3 volts. Much higher output is available at higher distortion levels, but 2 volts will be sufficient with most amplifiers to obtain maximum output.

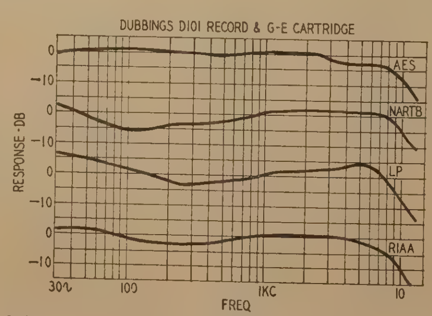


Fig. 4—AES equalizer response curve.

Separate bass and treble controls provide both boost and attenuation. The curves of Fig. 3, supplied by the manufacturer, indicate the range of control honestly and accurately. The treble boost is not great. This may be a disappointment to treble hounds but seems to me a wise precaution against misuse and consequent headaches, particularly since the response of the entire tuner is flat in the treble and requires no further treble boosting.

The record equalization follows previous Altec practice and is rather unusual. The phono switch offers three choices, AES equalization; crossover of 250 cycles but no treble equalization and 800-cycle crossover and no treble equalization. Treble equalization for the latter two positions can be obtained by manipulating the treble control. Since most records with 200- or 800-cycle crossovers are recorded flat in the treble, this is very satisfactory. The four curves in Fig. 4 show the response I obtained with the four American curves recorded on a Dubbings D-101. These were made with the tone controls in the neutral or flat position and the phono switch turned to AES equalization. It is evident that by and large the AES equalizer produces acceptable results from all the recording curves and does very well with the new ORTHO-RIAA curve. The bass and treble controls can be used to shape the phono response further.

The 303C is well built, handsome and reflects quality design throughout. It is primarily designed for use in custom-built home music systems where high-quality radio reception and phonograph reproduction are prime requisites. A front-view photograph of the 303C AM–FM tuner appears at the top of the opposite page.

New Records

Note: Records are 12-inch LP and play back with RIAA curve unless otherwise indicated.

BARBER: *Adagio for Strings*
DIAMOND: *Rounds*
COPLAND: *Quiet City*
CRESTON: *Two Choric Dances*
Capitol P-8245

This particular Capitol disc, I am sorry to say, is not one of their best. The definition is inferior throughout and the sound is dead, though this is partly a matter of miking. *Quiet City* and *Adagio for Strings* are duplicated in recent Mercury offerings and personally I found the Mercurys cleaner with better bass, better definition and more presence. Not that these are bad—by no means—they simply aren't up to the high standards achieved by others and Capitol previously.

All this music is worth listening to and, with a little patience, easy to listen to. The *Two Choric Dances* seem to me the most interesting in instrumentation. They would be excellent for indicating the contrast between the various types of basses, but unfortunately the recording itself does not show this too well.

The *Rounds* shows that Capitol can do better and this is the best of the lot. The highs are

bright and clean, the bass growls more, the fiddling strings have a nice sharp bite.

Good enough to enjoy and appreciate the music fully; but not for test, demonstration or show-off.

HINDEMITH: ***Symphonic Metamorphoses on Themes by Carl Maria von Weber***
SCHOENBERG: ***5 Pieces for Orchestra. Op. 16.***
Mercury 50024

This is definitely not for the layman or even the average music lover; it is for those who really like modern music. Don't let that part of the title about themes from von Weber fool you. Von Weber himself could listen for a month of Sundays without being aware that he contributed the themes, which, anyhow, are from obscure piano pieces, not the familiar overtures. Having made these reservations, let me add that those who can take it at all will find this music stimulating and with a fine sound, freer of artificial hi-hi effects than some of Mercury's more spectacular discs, clean and with a remarkably fine orchestral tone. The Scherzo of the Hindemith has excellent clean percussives of rather individual tone. The crescendos are exceptionally clean. There are very fine brasses and winds, and the sound of Orchestra Hall comes through faithfully.

The Schoenberg is remarkable for its sharp, snarling, snorting, growling brasses and winds —I know of no brasses like these. The whole work is excellent test material for definition, partly because of the 12-tone scale, but also because of the rather unique polyphony. There are some very subtle tonal nuances, even in the percussive sections. The opening of the second movement has some vibratos similar to those produced by multiple bell ringing. Later there is a very percussive bass, very deep. The whole thing is excellent for distortion testing because the exquisite dissonances (if you insist on calling them that) would be unbearable if compounded by distortion, especially in the finale. Unless the family and neighbors are connoisseurs of music this is certain to bring violent complaints if you play it loud enough to get the full benefit of the music. But that's your problem. I live in the middle of the woods and my wife has the faculty of mentally plugging her ears.

WALTON: ***Belshazaar's Feast***
London Philharmonic Promenade Orchestra
London Philharmonic Choir
Sir Adrian Boult conducting.
Westminster WL 5248

I have never cared much for cantatas, even Bach's, though I can listen to anything else he wrote all day long. But this disc may convert me. It is a moving work, displaying skillful use of voices and instruments to produce a highly emotional effect. The recording is possibly the most realistic treatment of mixed voices and orchestra in the catalogs.

The definition of both voices and instruments is phenomenal. The sibilants and other vocalizing transients are brilliantly reproduced. On occasions you can hear, not only the soloist, but the entire chorus drawing in its collective breath. The work employs an extraordinary number of instruments and, if you listen carefully, you can pick them out from the crowd. The percussives are notable and the bass is both very low and terrific in spots. Unquestionably one of the best recordings so far made. Even if you don't care for choral music, you'll find this useful for demonstration.

RIMSKY-KORSAKOV: ***Scheherezade***
Argeo Quadri conducting the Orchestra of the Vienna State Opera.
Westminster WL 5234

RIMSKY-KORSAKOV: ***Capriccio Espagnol***

RAVEL: ***Bolero***
Paul Paray conducting the Detroit Symphony
Mercury MG 50020

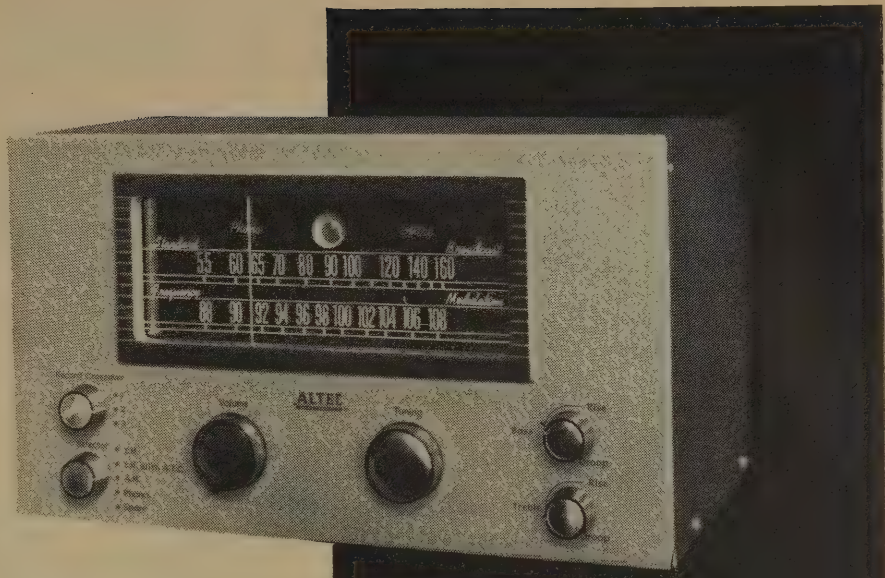
The trouble with most good hi-fi test and demonstration records is that, more often than not, the music is in the modern idiom which the ordinary layman and many music lovers find rather hard to take. It's pretty silly to demonstrate a system with material the listener doesn't like, but I concede I've been guilty of it myself. Here then are some discs which will make a hi-fi system sound stunning and still provide tuneful, unheadachy listening—well calculated in all respects to win admiring comments.

The Mercury *Bolero* is very clean and sharply defined. If you know your instruments, you should have no trouble listing the 18 choruses and the instruments involved in each one. The doubling of two dissimilar instruments in unison, but a couple of octaves apart, is clearly audible in the ninth, tenth and twelfth.

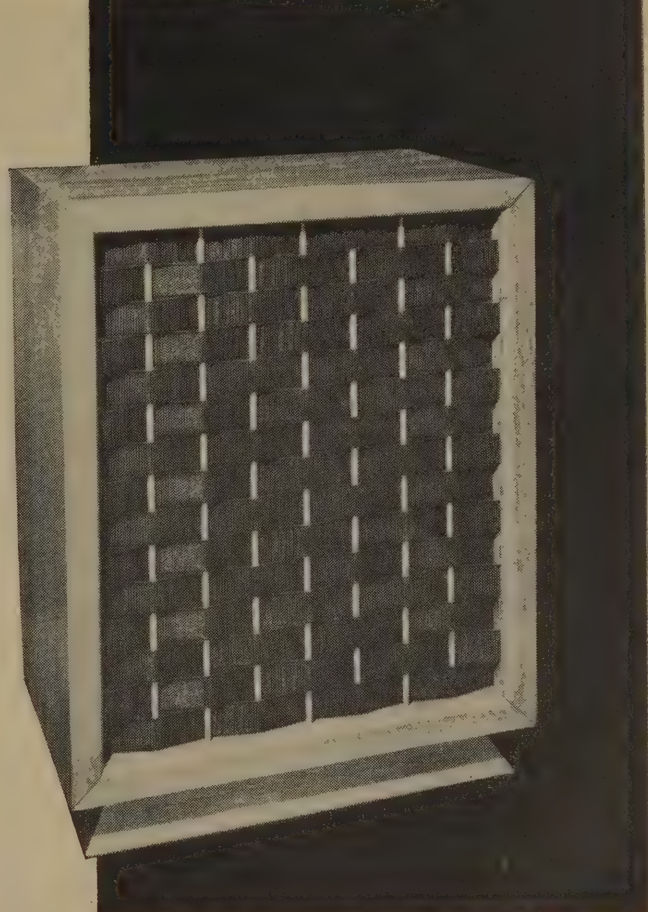
The *Capriccio* has a tremendous opening, excellent definition in peaks, a tone which is not only realistic but lovely throughout, sharp snare drums and a nice big, low-toned bass drum. The instrumental coloring, so distinctive of this music, comes through very nicely.

Westminster's *Scheherezade* is also stunning. The fine recording reveals every facet of the music. Even those who have heard it too often to be really fond of it should find it interesting. There is a fine double bass in the opening; the fingering on the solo violin is occasionally audible and the percussive highs in the third movement are as realistic as the dropping by a waiter of a trayful of cutlery. The resonance of the famous Konzerthaus comes through well; the fiddles in the fourth are very sharp; the drums in the final movement are really frightening—like Death itself knocking impatiently at the door or thunder shaking the foundations of the house.

Both these records are examples of the best of today's techniques and evidence how small is the gap between us and complete realism. END



The Altec 303C tuner, designed primarily for use in custombuilt home music systems.



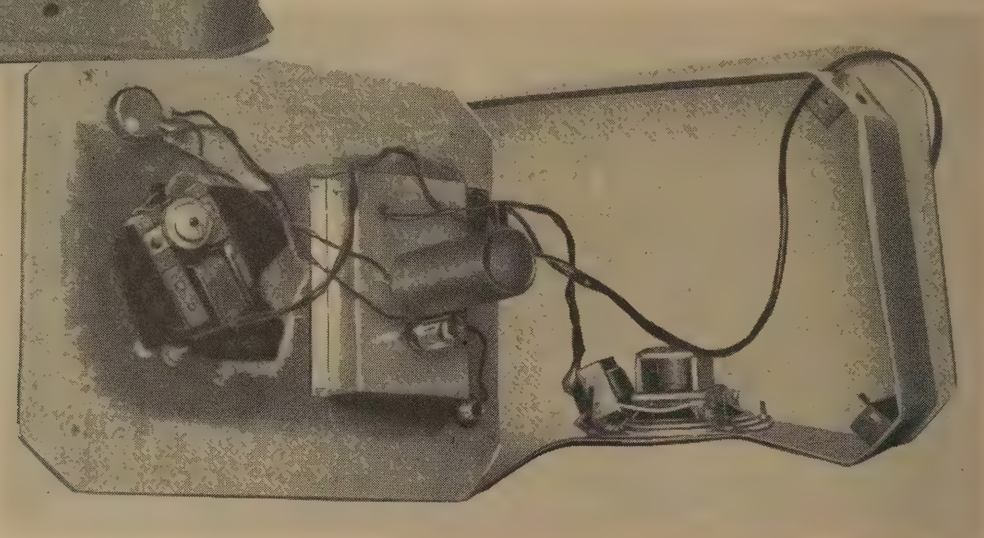
The "Grand" Boffle for two, three or four Hartley non-resonant speakers.

Junior Record Player-Amplifier

Phonograph features quick warmup, automatic shutoff

By NORMAN L. CHALFIN

The junior record player-amplifier.



Internal view shows parts mounted.

KIDS love to play records. Even the little 1-year-old reaches for the turntable or the arm to try to operate the record player. But for him most machines are too complex. There's the on–off switch, the volume control, the arm and finally the operation of shutting the machine off after the record is played or turning off the motor between records. On most children's record players the volume control and switch are one. Turning off the record shuts off all power and delays the start of the next record while the set warms up.

I've known youngsters to leave a record player on over night because the shut-off operation was forgotten. Others have cried because, when the record was started, there was no sound during the warmup delay—a half minute or more. This is nearly half of the playing time of some children's records. It was to eliminate these problems that this phonograph* was built.

The only operation necessary to set both the motor and amplifier in operation instantly is to lift the arm. By the time it is moved from the arm rest to the turntable the amplifier is warmed up. The motor starts even faster.

The circuit (Fig. 1) contains a one-tube power amplifier (battery type), a selenium rectifier and a Microswitch. The selenium rectifier provides plate and filament power for the 3V4 pentode amplifier. A dropping resistor from B plus to one side of the filament and a resistor from the other side of the filament to B minus make up a 50-ma bleeder system for filament current. The resistor in the B minus side provides grid bias.

A Microswitch built into the chassis assembly or attached to the underside of the top of the cabinet, directly beneath the arm rest, is the on–off control for motor and amplifier. It is normally closed; the weight of the pickup arm opens it. A rod through the pickup rest acts as a piston to depress the leaf of the switch. This opens the circuit as long as the pickup remains on the rest. The moment the arm is lifted, the pressure is released and the switch closes the circuits to both the amplifier and the turntable motor. There is no delay in the operation of selenium rectifiers, and it takes only a second or two until the filament of the 3V4 is heated.

No particular wiring precaution is necessary. Mount the volume control on the motor board (see photos). The output transformer is mounted on the speaker. The speaker and transformer are mounted on the front of the plastic wraparound. The important feature of this unit is the switch circuit and its operation through the pickup rest (Fig. 2). All other constructional details are arbitrary and any convenient cabinet arrangement will do.

A finer circuit that permits use of low-output pickups for three-speed operation is shown in Fig. 3. A three-speed motor is, of course, required. The leads between pickup, volume control

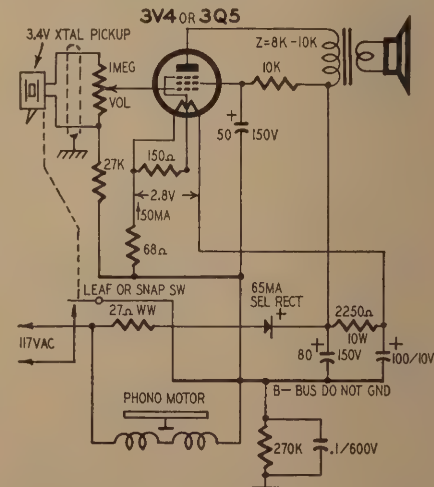


Fig. 1—The one-tube phono amplifier.

*U. S. Pat. No. 2,680,786

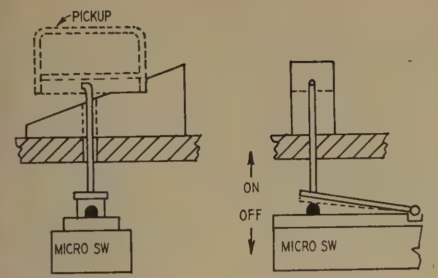


Fig. 2 (Left)—Details of the pickup rest.

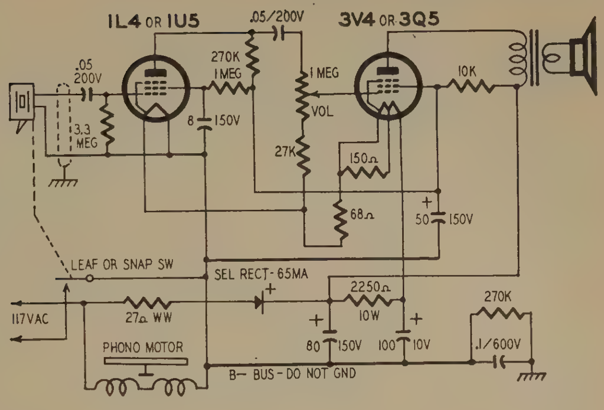


Fig. 3 (Right)—Schematic diagram of phono amplifier for low-output cartridge.

and amplifier input should be shielded because the low level and higher gain will make the circuits more sensitive to hum pickup. The tube lineup for the three-speed circuit is a 1U5 or 1L4 preamplifier and 3V4 power output stage.

(This record player uses a transformerless type power supply with one side of the line connected directly to a common B minus bus, so all precautions to minimize shock hazard must be taken.

The amplifier must be fully enclosed within a nonmetallic cabinet or case with all protruding screws or bolts which touch the chassis carefully countersunk and insulated. Note the author's cabinet construction. Be sure that the push rod in the pickup rest is made of nonconducting material. The pickup arm should be plastic and the cable between the cartridge and amplifier should be two-conductor type with an insulated shield. All ventilating holes should be adequately screened against tiny prying fingers. With these precautions, the phonograph is perfectly safe for even the smallest child. —*Editor*)

END

Parts for 1-tube amplifier

Resistors: 1—27 ohms, ½ watt, wirewound; 1—68 ohms, 1—150 ohms, 1—10,000 ohms, 1—27,000 ohms, 1—250,000 ohms, ½ watt; 1—2,250 ohms, wirewound, 10 watts; 1—1-megohm potentiometer.
Capacitors: 1—0.25 µf, paper; 1—50 µf, 1—80 µf, 150 volts, electrolytics; 1—100 µf, 10 volts, electrolytic.
Miscellaneous: 1—pickup arm (nonconductive); 1—crystal cartridge; 1—3V4 or 3Q5; 1—Microswitch, leaf type (normally closed; open when leaf is depressed); 1—selenium rectifier, 65 ma; 1—PM speaker, 3.2-ohm voice coil; 1—output transformer, primary impedance: 10,000 ohms, secondary impedance: 3.2 ohms; 1—78-r.p.m. motor and turntable; 1—chassis; 1—board for mounting chassis, motor, pickup arm and volume control; 1—rod for pickup rest (nonconductive); 1—cabinet; 1—power cord.

Parts for 2-tube amplifier

All parts previously listed (less motor, pickup arm and cartridge) plus the following: 1—250,000-ohm resistor; 1—1 megohm, ½ watt resistor; 1—3-megohm, ½-watt resistor; 2—.05-µf, 200-volt capacitors; 1—8-µf, 150-volt electrolytic capacitor; 1—1L4 or 1U5; 1—3-speed motor, pickup arm and cartridge.

HIGH-FIDELITY DICTIONARY

Part III

By ED BUKSTEIN

Overcutting

The result of excessively wide excursion of a cutting stylus, causing it to break through to an adjacent groove.

Overhead cutter

A cutting head assembly suspended above the disc as distinguished from a cutter mounted in the end of a swing-arm mechanism. The overhead cutter is mounted on a threaded shaft known as a lead screw, rotation of which moves the cutter from the edge of the disc toward the center.

Pad

A configuration of resistors designed to attenuate the signal without introducing impedance mismatch. (See Attenuator.)

Port

An opening in a loudspeaker enclosure other than the one behind which the loudspeaker is mounted. (See Reflex baffle.)

Preamplifier

An additional amplifier preceding the main amplifier. The preamplifier is generally used to build up the signal from a microphone or pickup to a value sufficient to drive the main amplifier. The preamplifier is usually, but not always, built on a separate chassis and may have its own power supply. The program selector (AM, FM, television, phono, etc.), equalizer, loudness control and bass and treble tone controls are often located in the preamplifier.

Pre-emphasis

The process and result of boosting the high frequencies during recording to increase the signal-to-noise ratio. This is necessary because the lateral swing of the cutting stylus becomes progressively smaller at the higher frequencies. In the playback equipment, the high frequencies must be de-emphasized to restore them to their correct relative level. Pre-emphasis and de-emphasis are also used in FM radio systems to improve the signal-to-noise ratio.

Presence

That quality of a sound-reproducing system that creates the illusion of listening to the original sound rather than to its reproduction.

Printing

The transfer of magnetic patterns from one layer of tape or wire to an adjacent layer on the spool.

Record noise

Noise voltages produced as the stylus passes over the granular surface of the record. Record noise is also known as *record scratch* or *surface scratch*.

Reflex baffle

(See Bass reflex enclosure.)

Reluctance

That property of a material which opposes the establishment of a magnetic field. Reluctance in a magnetic circuit corresponds to resistance in an electrical circuit.

Rumble

Low-frequency sounds introduced during recording (or during playback) by vibrations of the turntable or motor.

Shot effect

The random emission of electrons from the cathode of a tube. Since the number of electrons emitted per unit of time is not constant, the plate current is modulated by random fluctuations. These fluctuations increase the noise level.

Stereophonic

A sound-reproducing system designed to preserve some of the realism of the original sound by overcoming the *point source* characteristics of the loudspeaker.

The number of loudspeakers used in the reproducing system is equal to the number of microphones, and the physical arrangement of these loudspeakers corresponds to the arrangement of the microphones. In this way, each loudspeaker reproduces the sound the listener would have heard had he been located at the position of the corresponding microphone. TO BE CONTINUED

Adding VERSATILITY *to* MASTER INTERCOM UNITS

By JOHN T. FRYE

RECENTLY a contractor came to me with a problem, the solution of which may interest other service technicians. To understand the problem fully, the following facts must be known:

Several departments in the contractor's establishment were connected by Talk-A-Phone model KS-60 units in an all-master setup. A skeleton diagram of the input and output circuits of one of these units is shown in Fig. 1. In opera-

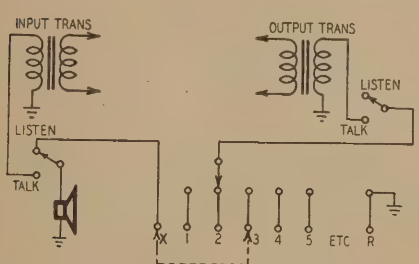


Fig. 1—Basic input and output circuits.

tion, similarly numbered terminals of all units have common connections, as do all R terminals. On the junction block of each station a jumper is run between the terminal number assigned that station and the X terminal. (Station No. 3 is shown in the diagram.)

The TALK-LISTEN switch is in its LISTEN position; the speaker of the unit is connected between terminals X and R. When this switch is depressed to the TALK position, the speaker is connected across the input transformer for use as a microphone, and the output of the amplifier appears between the numbered terminal to which the station selector is set and the R terminal. The amplifier is used only for talking. When one unit calls another, the amplifier of the station called must be turned on and warmed up, its selector switch must be set to the number of the station calling, and its TALK-LISTEN switch must be held in the TALK position to answer the call. Each operator must manipulate his TALK-LISTEN switch throughout the conversation.

The contractor wanted to retain the features of this all-master system. But in addition he wanted to use one unit as a control station from which he could call any other station and get an immediate answer from an operator at that station. All this without the operator's having to do anything but talk from wherever he might be standing in the room. Furthermore, the contractor wanted to add simple slave stations, in the form of PM speakers, at locations where it would not be necessary to originate calls but where the control station could call and get an answer.

At first this seemed like a large order; but after considerable diagram sketching, a simple solution was found. It was only necessary to mount a d.p.d.t. switch in a hole on the side of the cabinet and connect it into the intercom unit as shown in Fig. 2.

When this switch is in the MASTER position, the circuit is exactly the same

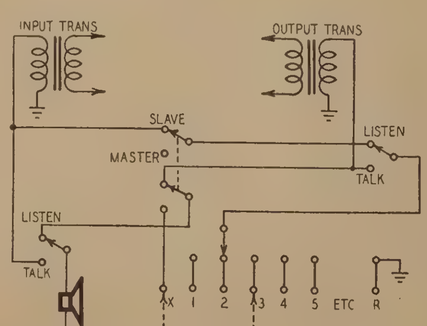


Fig. 2—Schematic of the revised circuit—MASTER-SLAVE switch is added.

as in Fig. 1 and the unit works in the all-master system just as always. The switch is normally left in this position. However, when this switch is thrown to SLAVE, the speaker of the unit to which the station selector is adjusted is connected across the input transformer in the LISTEN position and the control station's own speaker is across the amplifier output. In the TALK position, the control-station speaker becomes a microphone, and the output of the amplifier goes out through the numbered terminal to which the station selector is set and the R terminal to the speaker of the remote unit. In short, throwing the switch on the control station to SLAVE converts all other master units into slave stations.

An advantage of this is that stations called by the control station do not have to be turned on or manipulated in any way to respond. Only the operator of the control station needs to operate a TALK-LISTEN switch. This is especially helpful in calls to a location where the person answering may not be able to leave what he is doing. Extra slave stations can be added to the system for use by the control station simply by running leads from an unused numbered terminal and the R terminal on the nearest junction block to the voice coil of a PM speaker.

A converted master station can be used with a single slave station wired as shown in Fig. 3 so that calls may orig-

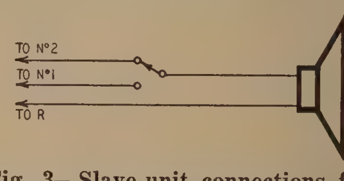
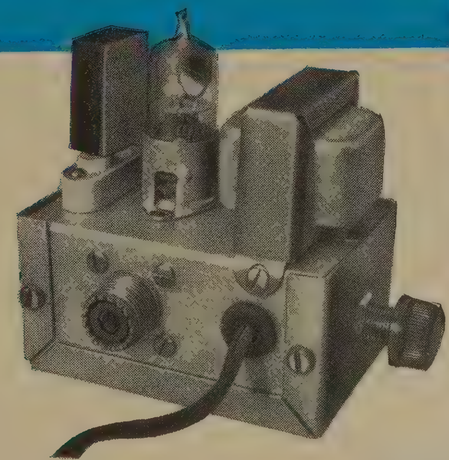


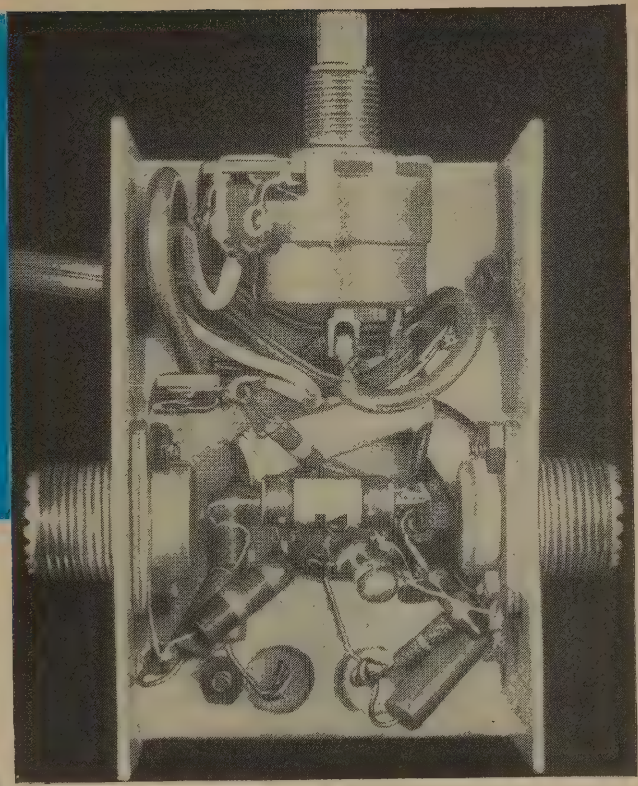
Fig. 3—Slave-unit connections for use with converted master station.

inate from either end as long as the amplifier of the master station is turned on. A s.p.d.t. switch is used, spring-loaded to remain normally in the position shown. The station selector of the control station is normally left in position No. 1, which means nothing will be heard at either end. When the slave-station operator wishes to originate a call, he holds the switch down so that the speaker voice coil is connected into the input of the control station through the SLAVE switch contacts. The control-station operator answers by holding his TALK-LISTEN switch down to talk and letting is up to listen. If he turns his selector switch on position No. 2, it is not necessary for the slave-station operator to hold his switch down during the conversation.

When a control station is working with a single slave station or is working in an all-master system, the control-station operator can listen in on any station in the system simply by throwing the MASTER–SLAVE switch to SLAVE and by setting the station selector to the number of that station. Depending upon the circumstances, this may or may not be an advantage! END

SIDEBAND MODULATOR for MARKER GENERATOR





Left—Top view of the sideband modulator.
Right—The sideband modulator underchassis.

By BRUCE A. MORRISSETTE

TV front ends and i.f. amplifiers are generally aligned with a setup similar to that in Fig. 1. Unless the marker generator can produce multiple pips, the technician is limited to the single marker frequency provided. Adding a simple, compact, self-powered sideband modulator, as shown in Fig. 2, will place additional pips on the response curve. They will be separated from the main marker point by the crystal frequency of the sideband unit.

For the alignment of front ends, a 4.5-mc crystal will place a sideband marker on the response curve at a point indicating the position of the audio carrier, if the marker generator is set at the video carrier frequency (or a submultiple thereof). Fig. 3 shows an idealized front-end response with video and audio carriers

The sideband modulator yields the curve of Fig. 4 for i.f. alignment. Here the marker generator is set at the video i.f. carrier frequency (26.4 mc in this example) and a 1.5-mc crystal is used in the sideband unit. Pips are then produced at the adjacent-channel audio point, at 1.5-mc intervals across the top of the curve (indicating bandwidth) and at the audio i.f. carrier (here, 21.9 mc). If the marker generator is set accurately, all important points on the response curve will be indicated simultaneously.

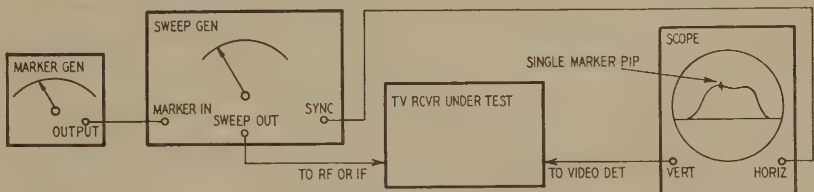


Fig. 1—Conventional alignment setup.

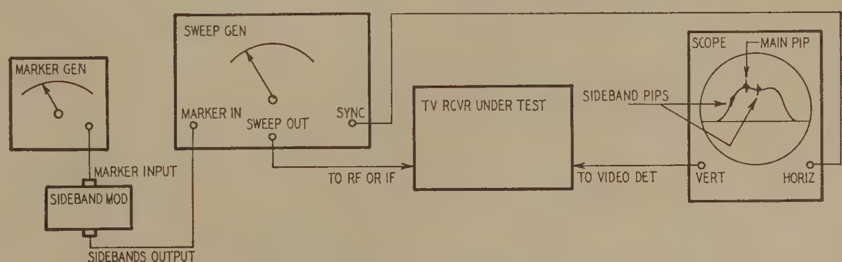


Fig. 2—Using the sideband modulator.

A low-frequency crystal (100 to 250 kc) is used for sound detector alignment and linearity adjustment. Fig. 5 shows 100-kc sideband markers on either side of the discriminator or ratio detector response curve. For intercarrier TV sets, the center frequency of 4.5 mc may be spotted by inserting a 4.5-mc crystal into the sideband modulator unit and turning the marker generator off.

A triode Pierce crystal oscillator with cathode-follower output is capacitively coupled to a wideband crystal diode modulator (Fig. 6). Values are chosen to permit operation over a wide range of crystal frequencies. Connecting the grids and plates of the 6J6 in parallel produces strong oscillation. The 100-ohm resistors at the input and output connectors give wideband characteristics to the 1N34 crystal diode series modulator, so polarized as to strengthen sideband amplitude.

Surprisingly, no d.c. plate supply is required. I noticed no difference in performance when the unit was supplied with rectified and filtered d.c. This not only saves space and the cost of a rectifier and electrolytic filter capacitors, but provides an added feature—the crystal oscillator output is strongly modulated at 60 cycles. Thus, the sideband unit may be used as a crystal calibrator,

the modulation permitting identification of fundamental and harmonics on standard AM communications receivers.

The modulation does not affect the appearance of the response-curve pips, which have the typical "birdie" agitation of beat-frequency markers. When operating the unit, be sure that the "on" period of the modulator crystal corresponds to that of the sweep generator oscillator if blanking is used. The procedure is simple: If sideband pips appear, the two instruments are in phase. If no sidebands are visible, reversing the a.c. line plug of *either* unit will restore the pips.

If for any reason the constructor wants to use a d.c. plate supply (Fig. 7), it should be inserted at point X in Fig. 6.

Pip size is controlled by a carbon potentiometer, useful in setting the output level below the point which may cause distortion of the alignment curve. Since the entire device is designed to work at a low level, only a minimum of r.f. signal from the marker generator should be inserted at J1. Alternate manipulation of the marker generator amplitude control and the PIP SIZE control will establish the proper amplitude ratio for best sideband operation.

Construction

Eliminating the d.c. supply permits the entire device to be housed neatly in a 2 x 3¼-inch aluminum Minibox. The power transformer, of the miniature type used in TV boosters, was at the time of writing available from Burstein-Applebee in Kansas City (stock No. 19C714). Half-watt resistors and ceramic capacitors help conserve space. I had Amphenol type 83-IR u.h.f. connectors on hand; others may be substituted.

Arrangement of parts, as shown in the photos, is straightforward. If a miniature power transformer is not available or a d.c. plate supply is desired, a larger Minibox can be used. The entire unit may also be built into a marker or sweep generator. The additional heater drain is slight and should not overload the marker or sweep generator transformer. The oscillator plate current can be taken from the d.c. B plus line through a dropping resistor (about 120 volts is required with the PIP SIZE control at maximum).

Additional applications

There are several worth-while additional uses of the sideband modulator:

1. **Crystal calibrator.** A 100-kc, 1,000-kc or other crystal standard can be plugged in and the output taken from connector J2. The 60-cycle modulation permits easy identification of all harmonics, which extend well into the television intermediate frequencies (as high as 50 mc). A signal or marker generator may be calibrated or checked against the crystal standard by connecting it to terminal J1 and viewing successive beats on a high-gain oscilloscope connected to J2.

2. **Response-curve calibrator.** This function should not be confused with the production of sideband markers. Sideband markers are fixed only in relation to the main movable marker pip, and all pips *move together* as the marker generator is tuned across the curve. In response-curve calibration, the pips are *stationary* and represent fixed frequencies across which the marker pip may be moved. To secure this absolute, not relative, calibration of a response curve, the marker generator is not fed through the modulator unit.

With J2 connected to the marker input terminals of the sweep generator (or otherwise coupled to the circuit under test), a crystal with harmonic relationship to the i.f. passband—4.5 mc, for example—is inserted. At the point on the passband corresponding to the appropriate harmonic (the fifth harmonic of 4.5 mc, or 22.5 mc) a stationary pip will appear. This pip may also be used to calibrate the marker generator, fed into the circuit under test beyond the point where the sideband unit and the sweep generator are connected. Crystals with fundamentals of 1 or 1.5 mc will place check points across the entire curve. Once a specific point on the curve is marked with a high-frequency crystal (such as a 4.5-mc unit), the close-spaced pips may be used to identify the frequency of points all along the response curve.

3. **High-frequency crystal detector and heterodyne mixer.** With the power disconnected, the crystal diode circuit of the sideband modulator may be used to indicate r.f. power at frequencies extending through the u.h.f. television bands. A microammeter connected to either J1 or J2 (observe polarity of current flow) will indicate r.f. fed into the opposite connector. If enough r.f. voltage is present in the sources, two signals may be fed into one connector and the difference frequency recovered from the other. The difference signal can then be amplified by any appropriate amplifier (i.f. strip, video amplifier, scope or audio amplifier, depending on the range of difference frequencies involved). Variations in the output amplitude of sweep generators across a given sweep band can be checked by feeding the swept signal into J1 and viewing the output from J2 on a high-gain oscilloscope.

4. **TV horizontal linearity bar-pattern generator.** For this function, the sideband unit is supplied with a marker frequency corresponding to any convenient video channel, or a submultiple thereof. A low-frequency crystal (100–250 kc) inserted into the modulator will produce a number of vertical bars on the picture tube. Adjustments can then be made to give the best equal spacing of the bars. For best results as a bar-pattern generator the unit should have a d.c. plate supply. END

Parts for sideband modulator (Fig. 6)

Resistors: 2—100, 1—150, 1—47,000, 1—56,000 ohms, ½ watt; 1—500,000 ohms, potentiometer.
Capacitors: 1—25 μμf, 1—250 μμf, 2—.001 μf, 1—.006 μf.
Miscellaneous: 1—1N34 crystal; 1—power transformer, primary: 117 volts, secondary: 110 volts @ 20 ma, 6.3 volts @ 0.3 amp (Burstein-Applebee No. 19C714 or equivalent); 2—connectors (Amphenol 83-IR or equivalent); 1—on-off switch (may be mounted on potentiometer); 1—crystal holder; 1—7-prong miniature socket; 1—6J6; 1—Minibox chassis, 2 x 3¼ inches; 1—knob for potentiometer.

Parts for d.c. power supply (Fig. 7)

1—2,200-ohm resistor, ½ watt; 1—35-ma selenium rectifier; 1—20-20 μf 150-volt electrolytic capacitor.

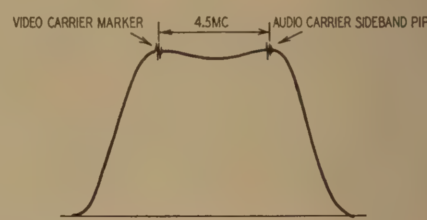


Fig. 3—A front-end response pattern.

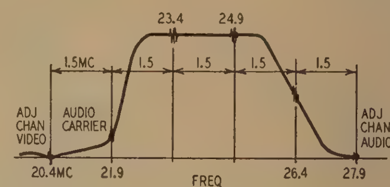


Fig. 4—Sideband unit provides pips.

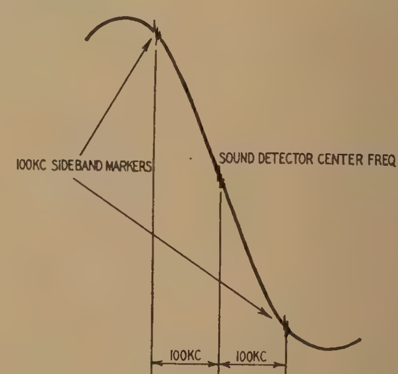


Fig. 5—Sound detector response curve.

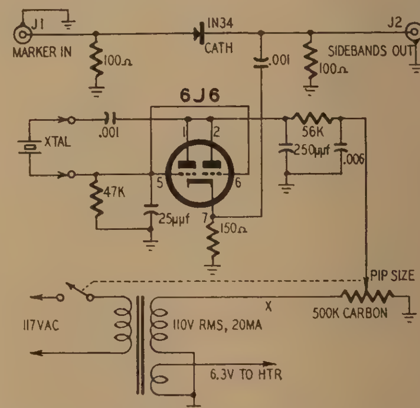


Fig. 6—Schematic diagram of the sideband modulator without a d.c. supply.

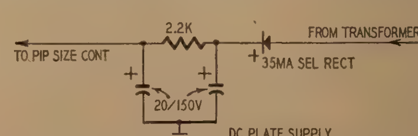


Fig. 7—Diagram of d.c. plate supply.

A LABORATORY TYPE TUBE TESTER

A checker to meet the demands of increasingly complex equipment

By JOHN A. DEWAR

TRANSCONDUCTANCE tube testers are a great improvement on the emission type but have their limitations. The instrument described in this article (Fig. 1) is superior to them in that it tests tubes under working conditions: grid bias and plate and screen voltage can be set to any desired value. Plate and screen currents are metered and transconductance is read directly by applying a 1-volt r.m.s. signal on the grid and measuring the output in a.c. milliamperes.

The instrument is not as complicated to operate as the large number of controls would suggest and, while it takes longer to test a tube, it actually saves service time by accurately establishing a tube's condition.

A Heath emission type tester built in the unit simplifies construction. It can be used as an emission tester, as originally designed, to test diodes, rectifiers and for short-circuit tests. For transconductance tests the Heath tester supplies the sockets, heater voltage, line meter, and line voltage adjust for the bias supply and audio oscillator. Any free-point tester can be used in the same way.

Oscillator and bias supply

Fig. 2 shows the half-wave rectifier that supplies up to 40 volts negative bias, the full-wave rectifier that supplies the oscillator and the meter that measures injection signal voltage. Potentiometer R1 adjusts the negative grid bias. The 1-volt grid input signal is adjusted by R2 and metered by the 6C8-G and 0–2-ma meter. One section of the 6C8 is used as an isolating cathode follower to prevent clipping of the signal voltage; the other section is a d.c. amplifier, making a sensitive meter unnecessary. The 0–2-ma meter was calibrated to read 0–3 volts a.c. at 2,000 cycles.

An audio oscillator operating in the region of 2,000 cycles was chosen in preference to the 60-cycle line frequency because it produces less loss in the plate a.c. meter. For instance, with the setup shown in Fig. 3, a 1-volt 60-cycle signal shows only 30% of the output compared to a 2,000-cycle signal.

The oscillator transformer is a 1:1 push-pull input in a Hartley circuit. Since the center tap overexcites it, some juggling with plate voltage, grid resistor and capacitor was necessary to produce a good sine wave. It may be necessary to depart from specified values when a transformer of another make is used. Loading the secondary with the 10,000-ohm potentiometer decreases the effective primary inductance, increasing the frequency and improving the waveform.

Plate and screen supply

The 1619 tubes act as rectifiers (Fig. 3) and variable voltage controls at the same time—the two 500,000-ohm potentiometers vary the grid voltage. The power transformer is a replacement type for 2.5-volt radios (can be taken from an obsolete radio). It should have two 2.5-volt windings or the 5-volt winding can be reduced to 2.5 volts with a series resistor.

Screen voltage can be varied from 50 to 400. The plate supply can be varied from 50 to 400 volts except with output tubes drawing a large current, which drops it to 250 volts at 50 ma. A higher voltage transformer would increase the plate supply voltage but 250 volts is adequate. Since the screen current requirements are small, any high-resistance choke or audio transformer winding can be used for filtering.

The a.c. component of the plate current is the measure of a tube's transconductance. With 1 volt a.c. applied to the grid, the a.c. plate current can be

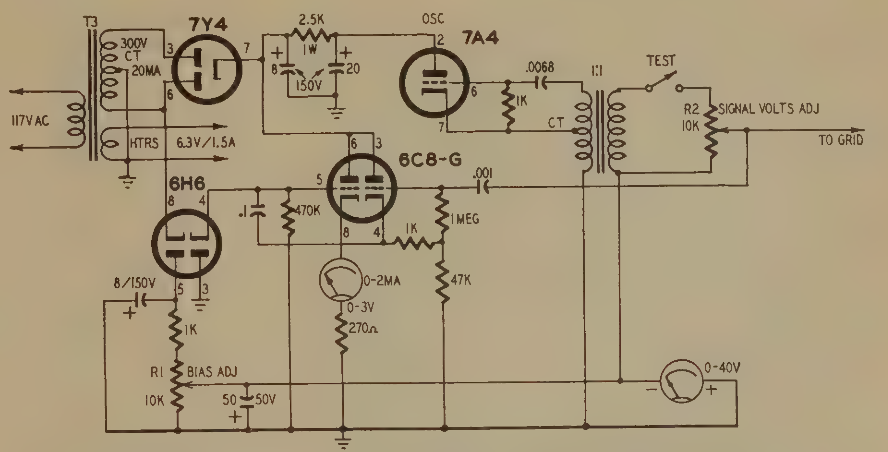


Fig. 2—Schematic diagram of the audio oscillator and the grid bias supply.

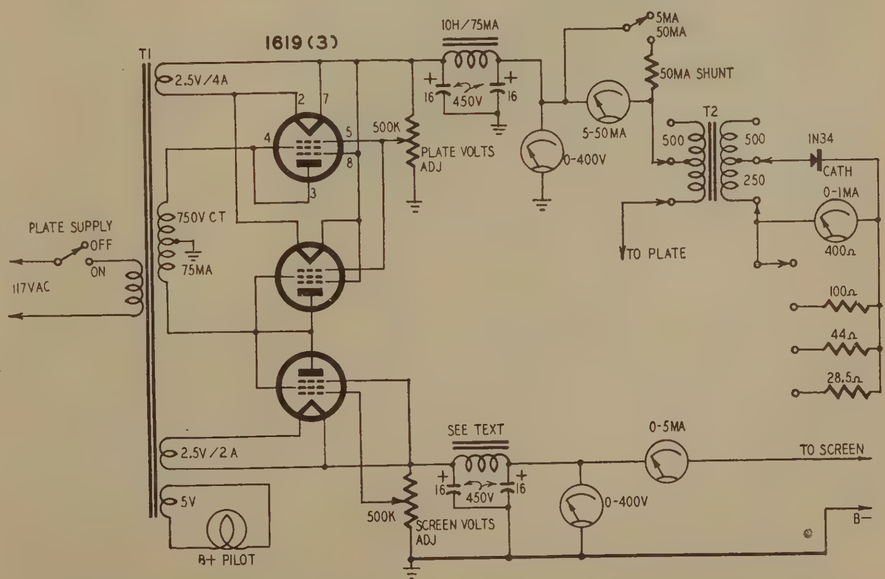


Fig. 3—Schematic of plate and screen supply of the transconductance meter.

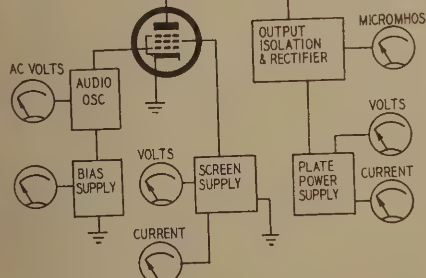
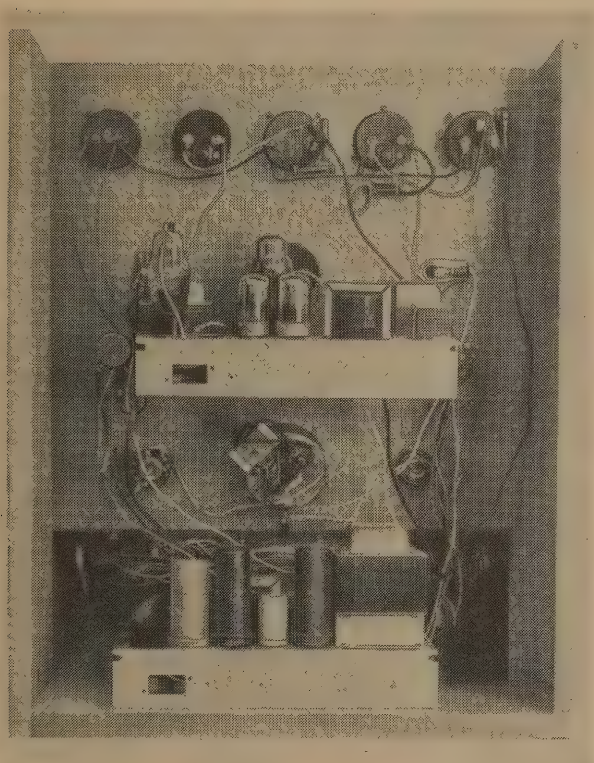


Fig. 1—Block diagram shows basic layout of the laboratory type tube tester.

Front of the laboratory type tube tester.



Rear view—chassis and major components.

easily translated into micromhos; that is, 1 milliampere a.c. is equal to 1,000 micromhos. Measuring this a.c. poses several problems: the d.c. plate current component must be isolated, losses must be kept to a minimum, and the impedance introduced in the plate circuit must be kept to a low value compared to the tube's load resistance.

Many arrangements were tried and the circuit shown in Fig. 3 proved best. For isolation, a line mixing transformer is used. This has a center-tapped 500-ohm primary and a 500-ohm secondary with 250- and 500-ohm taps. Its current rating is 100 ma. Secondary current is rectified by a 1N34 crystal diode and measured on a 0–1-ma meter. This combination is efficient but some losses occur so it is necessary to increase the signal voltage to slightly above 1 to compensate for them.

The 3-inch meter used has a basic movement of 1 ma, with 400 ohms internal resistance. It is from a surplus altimeter and has a 260° scale which gives lots of room for calibration. A total of four calibration ranges were used with the 1-milliampere meter:

1. Basic 0–1 ma—0–1,000 μmho
2. 100-ohm shunt, 0–5 ma—0–5,000 μmho
3. 44-ohm shunt, 0–10 ma—0–10,000 μmho
4. 28.5-ohm shunt, 0–15 ma—0–15,000 μmho

A new meter scale, calibrated in micromhos, was made by cementing numbers (cut from a tube manual) on thin black card pasted over the original scale. For a meter of different internal resistance other values of shunt resistance must be calculated.

In testing filament type tubes the a.c. in the filament causes an a.c. voltage to appear on the grid, giving a reading on the output meter. To balance this out a 100-ohm potentiometer (Fig. 4) is connected from 0 to the 3.3-volt tap on the filament transformer (in the Heath kit tester) and the B minus or ground connection to the moving arm. This is adjusted for zero reading on the output meter before the tube is tested. For cathode types it is set to off position.

Construction

Standard 19-inch steel panels were used, screwed to a wooden rack. I recommend some more easily worked material than steel. The instrument shown in the photos is larger than necessary. This was an experimental model and I allowed space for changes and additions.

The outlay in time and material to build this tester is considerable but well worth while in view of its usefulness. A similar manufactured job costs in the neighborhood of $1,000.

Ten single-pole 5-position rotary switches are grouped, five on either side of the emission tester. These are numbered and connected as follows (see Fig. 5): Switch 1 connects to pin 1 on all sockets; switch 2 connects to all No. 2 pins, and so on. On the Heath tester the lead from pin No. 1 on all sockets is removed from switch A and connected to position 1 on switch 1. This is marked RETURN and connects back to lever switch A. Similarly with switches B through to K. All tube-element selector switches are marked:

Position

1. Return—back to emission tester
2. Plate—to output meter and plate supply
3. Screen—to screen supply
4. Grid—to audio oscillator and bias supply
5. Off—open circuit

The five meters on the top panel are:

Plate volts, 0–400; plate current, 0–5–50 ma (value of shunt must be calculated from meter's resistance); screen volts 0–400; screen current, 0–5 ma; grid bias volts, 0–40. To keep construction costs down surplus meters with 5-ma movements were used. These act as light bleeders on the power supplies, a desirable feature. To have all pertinent measurements simultaneously

indicated without switching is a great advantage since plate, screen and bias variations interact and must be observed for a final adjustment. The meters are shown in the schematics with their associated equipment and not separately, as on the panel.

Calibration

Scale multiplication can be checked by setting a tube to read exactly 1,000 μmho. Switch to the 5,000-μmho range and check that it reads 1,000. Similarly adjust another tube to 5,000 μmho and switch to the 10,000-μmho range, and so on.

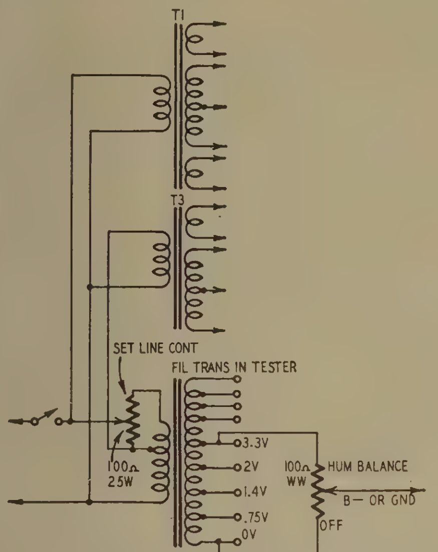


Fig. 4—Connecting the hum-bucking potentiometer to the filament transformer.

Accuracy of measurement can be checked by using a number of known good tubes of the same type and taking an average of them. They will vary because of production tolerances. Plate, screen, bias and heater voltages must be accurately set. Check accuracy of instrument meters with a v.t.v.m. known to be accurate. The signal-voltage meter (basic 0–2 ma) was calibrated against an a.c. v.t.v.m.

High-transconductance type tubes tend to oscillate at u.h.f. in some testers, giving an inaccurately high reading. This tester has not shown such a fault. In fact in several months' use it has proven accurate, very useful and free from bugs.

Operation

Since the emission tester's lever switches A to K represent pin connections 1 to 10, these have been so numbered on the panel for ready reference. In center (neutral) position all connections are to the filament tap. Similarly, the other 10 element switches are on RETURN. Using a tube manual, let us test a 6K7. Plate supply off. Test for shorts. Then:

Pin 1—shield. Lever switch down, to ground.
Pin 2—heater—center, as is.
Pin 3—plate—lever down, switch 3 to plate.
Pin 4—screen—lever down, switch 4 to screen.
Pin 5—suppressor—lever down to ground.
Pin 6—no connection—center, as is.
Pin 7—heater—lever down. Filament selector to 6.3 volts.
Pin 8—cathode — lever down to ground.
Cap —grid — lever 10 down. Switch 10 to grid.

Turn on B plus. Consulting tube manual set:

Plate current range to 50 ma.
Plate volts to 250.
Screen volts to 100.
Grid bias to − 3 volts. (It is advisable to keep the bias high at the start to prevent plate current meter overload.)
Set output range to 5,000 μmho.

Depress test switch, set signal volts to 1, read micromhos.

Plate current should be around 7 ma, screen current 0.8 ma.

Transconductance should read around 1,450.

The tubes indicated were used because they were on hand. Any other tubes of similar type can be substituted, such as: 6X5, 6X4 for 7Y4; 6J5, 6C5, etc. for 7A4; 2A3, 6L6, 807, etc. for 1619. Of course 6L6's or 807's will require a different power transformer, with 6.3-volt windings and the B plus switch changed from the line to the B minus return because they are slow to heat.

Substituting for the 6C8 would require circuit changes. Values chosen for the d.c. amplifier were picked for this tube and meter. A few additional notes: Always have the plate supply off when setting switches. Start setup with the 10 element switches on RETURN and lever switches in center–neutral. Check to see that all switches are correctly set before turning on power supply. See that line voltage meter is on "line test" to insure correct heater voltage.

Complete flexibility allows tests under widely varying conditions and the drawing-up of E_g–I_p curves and other characteristic graphs. END

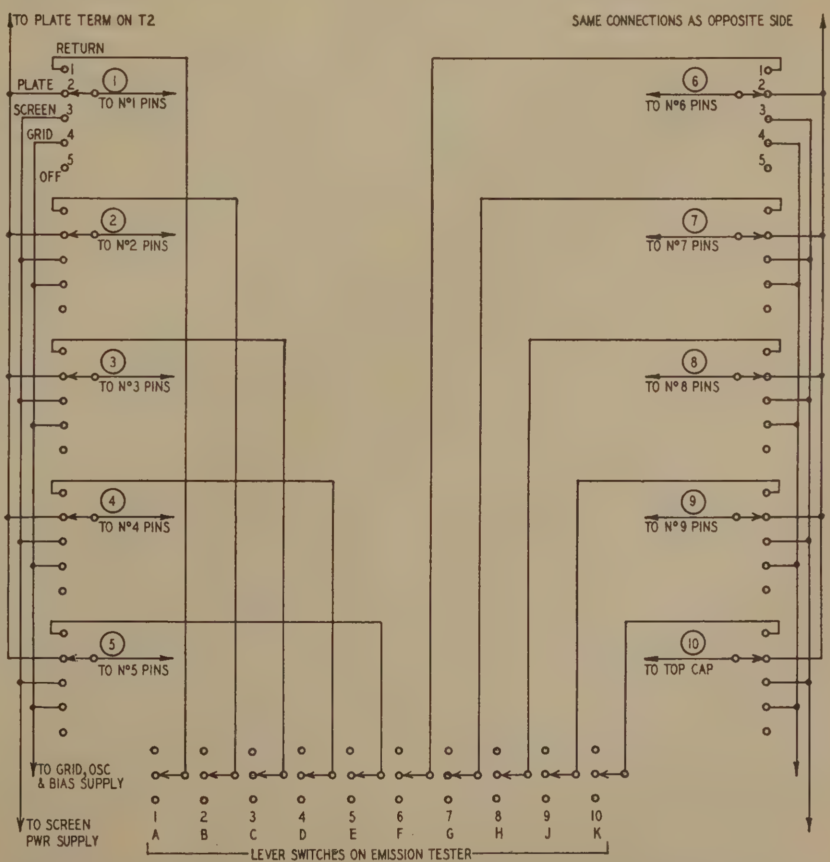


Fig. 5—Tube-element selection switches connected to the emission tester.

Parts for tube tester

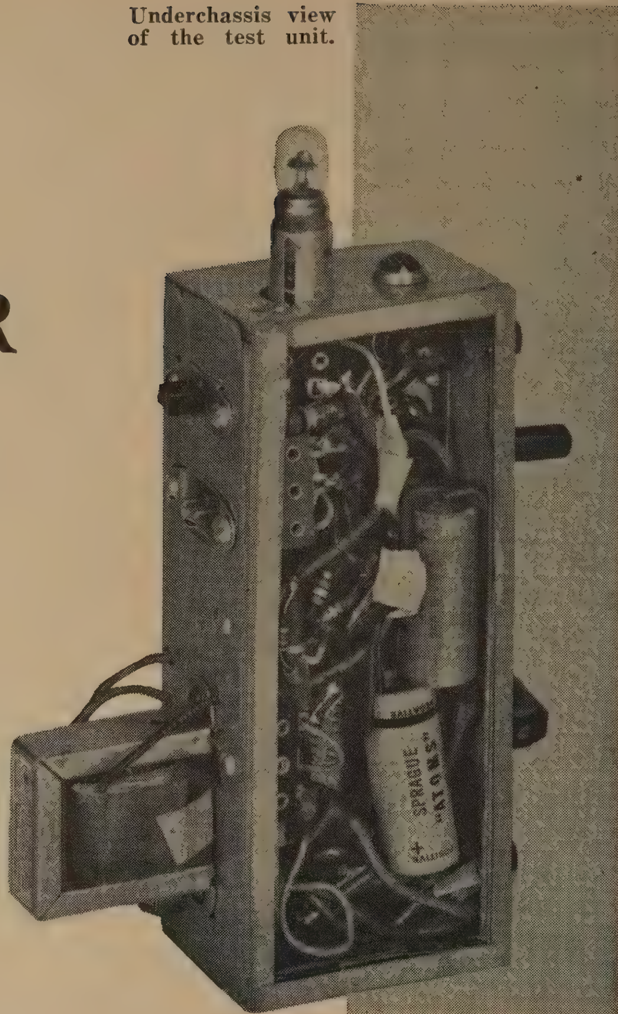
Resistors: 1—270, 3—1,000, 1—47,000, 1—470,000 ohms, 1—megohm, ½ watt; 1—2,500 ohms, 1 watt; 3—precision resistors (meter shunts, see text); 1—100-ohm wirewound potentiometer; 2—10,000, 2—500,000 ohms, potentiometers.

Capacitors: 1—.0068 μf, 1—.001 μf, 1—0.1 μf, 200 volts; 1—8 μf, 1—8-20 μf, 150 volts, electrolytics, 1—50 μf, 50 volts, electrolytic, 2—16-16 μf, 450 volts, electrolytics.

Miscellaneous: 1—7Y4, 1—7A4, 1—6H6, 1—6C8-G, 3—1619, tubes; 2—0-400 volts, 2—0-5 ma, 1—0-1 ma, 1—0-2 ma, 1—0-40 volts, meters; 1—1N34; 1—pilot lamp and holder; 1—power transformer, 2.5 volts @ 4 amp, 2.5 volts @ 2 amps, 750 volts c.t. @ 75 ma; 1—power transformer, 300 volts c.t. @ 20 ma, 6.3 volts @ 1.5 amp; 1—choke, 10 h @ 75 ma; 1—choke (see text—any high-resistance choke or audio transformer winding); 1—oscillator transformer, 1:1 ratio, 1 side center-tapped; 1—line mixing transformer, primary 500 ohms, secondary, 500 ohms with a 250-ohm tap; 3—s.p.s.t. switches; 10—single-pole 5-position switches, rotary non-shorting; 1—chassis for oscillator and bias supply; 1—chassis for plate and screen power supply; 1—emission type tester; 1—single-pole 4-position rotary switch; 1—mounting panel.

CAPACITOR TESTING with your OHMMETER

Underchassis view of the test unit.



Used with multimeter, unit provides reliable check

By SOL D. PRENSKY

THE ohmmeter, so tremendously useful for continuity and resistance checks, is no great shakes for capacitor testing. The service technician generally makes fine use of the versatile volt-ohm-milliammeter; but when it comes to testing capacitors, he finds that the resistance-measuring circuit of the ohmmeter gives him only a very limited ability to spot an open or a badly shorted capacitor. It fails to give any effective overall "good-or-bad" test on many important in-between defects.

The weakness of the ohmmeter circuit in testing capacitors stems from the fact that it basically measures current flow in a low-voltage battery circuit. Thus, the ohmmeter is virtually useless for indicating critical capacitor leakage at rated voltage.

Consequently, when the occasion arises where a capacitor must be tested, the technician has two alternatives: He may use a capacitor tester which provides leakage and capacitance measurements under rated-voltage conditions, or stoop to the time-wasting system of substituting good capacitors all over the lot.

Many manufacturers of 20,000-ohm-per-volt multimeters include directions for capacitor testing in their instruction booklet. Such directions, in general, point out that it is possible to use the current ranges (and sometimes voltage ranges) to measure leakage by placing the milliampere range of the meter into the power supply of the set, in series with the suspected capacitor. This method, while theoretically giving a much better test, is not very satisfactory from a practical standpoint. Among other things, it involves using the current range of the meter on the live set. It would be much better if we were able to retain the advantage of test-prod probing with the multimeter without the danger of damage to the meter by incorrect operation with the set turned on. Such a method is described in this article.

The primary objective of this unit is not to measure capacitance, but to provide on the meter a *practical good-bad indication* of the merit of the capacitor. The neon lamp serves in a minor role, absorbing large discharge currents. While doing this, it shows the heavy discharge currents to be expected from large electrolytics (4 to 40 μf). Though the neon flash might be used for a fast check on these capacitors, the determination of discharge ability is available on the meter at all times.

The capacitor tester (see photo) is compact, small enough to be attached to the side of a multimeter without interfering with the portability of the instrument. It provides:

1. A power supply for 25, 50, 150, 300 and 450 volts d.c. output.
2. A leakage measurement by the current scale of the meter, on charging a capacitor—with the meter circuit fully protected during this test.
3. A discharge test with indication, in the meter circuit, of the charge-holding ability of a capacitor.
4. Switching circuits for applying the proper value and polarity of test voltages, according to the type of capacitor being tested.

Circuit operation

The d.c. test voltages are obtained from the self-contained power supply and are selected by the six-position switch. The test voltages are produced in the power supply (Fig. 1) by a selenium rectifier stack arranged in a voltage-tripler circuit. The current requirements for these test voltages are very modest, being no more than around 50 ma for short periods—the maximum leakage expected from even the largest good electrolytic that would commonly be tested (100 μf at 450 volts). Current demand for more than 50 ma occurs only with defective capacitors. In these cases, any larger current need

The test chassis in operating position.

flow only for the few seconds it takes to determine that the capacitor is bad. There is, therefore, no problem with temperature-rise effects from continuous current, and the power supply can be made inexpensive and compact. Operating from an isolation transformer, the supply uses three miniature (65-ma) selenium rectifiers and instantly produces the required test voltages. The maximum current delivered by the supply is limited by R1 and R2 to a safe value for the meter, so that relatively large instantaneous charging currents or even a dead short will not cause excessive meter overload.

Capacitors are tested in the charge (Fig. 2) and discharge (Fig. 3) circuits. The capacitor to be tested is first isolated by lifting one end free while the set or other device of which the capacitor is part is de-energized. Jumper leads from the capacitor tester pin jacks are plugged into the meter, and the regular test leads are used at two other pin jacks of the tester. Up to this point no testing action takes place, since the charge–discharge switch is still open, allowing the connections and the meter-range switch positions to be checked for correct test conditions, as given in the tables.

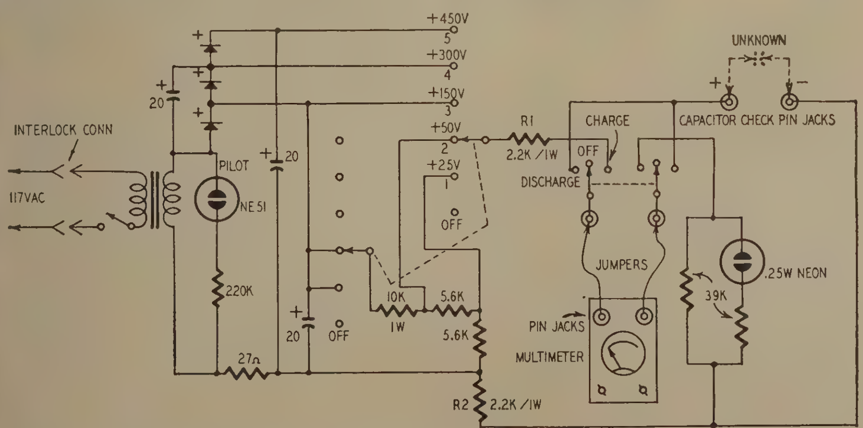


Fig. 1—Schematic diagram of the capacitor test unit. All values are shown.

When a capacitor is to be tested, turn on the power to the capacitor tester. The testing steps follow the order given in the test table. The following points are in addition to the directions in it.

1. Set selector switch to test voltage desired (25, 50, 150, 300 or 450), preferably using wherever possible the test voltage next higher to the rated d.c. working volts.

2. The meter range for CHGE position is set for MA (d.c.) or D.C. volts as directed by the tables. (On the d.c.-volt range, the charging current flows through the input resistance of the meter and gives a very sensitive but safe current range—about 50 μa—even though we read on the voltage scale.)

3. Press CHGE switch. The meter pointer will swing over and then stabilize. (With electrolytics, allow time for the capacitor to form, especially if it has been out of use for some time.) If leakage current is excessive after the needle stabilizes—within a few seconds—the capacitor should be rejected. Otherwise, proceed with the next step.

4. Return the CHGE–DISCH switch to neutral mid-position.

5. The meter range for DISCH position is then set. This is usually some a.c. volts range on the multimeter, where the nonlinear action of the meter rectifier is used to produce a more easily read discharge indication. Upscale deflection of the meter on DISCH is obtained by the circuit-reversing action of the switch in DISCH position. This also produces forward current through the meter rectifier in the usual 20,000-ohm-per-volt type of multimeter circuit. (This can easily be checked for a particular multimeter by reversing the leads to the multimeter terminals before pressing the DISCH switch and observing which connection gives the larger reading.)

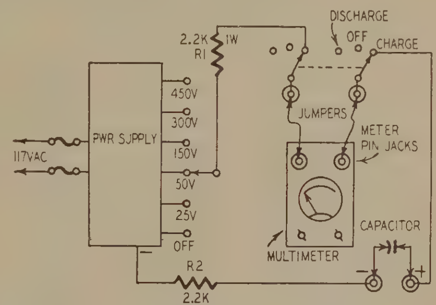


Fig. 2—Schematic of the charge circuit.

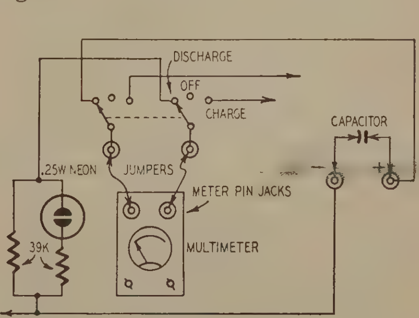


Fig. 3—The basic discharge circuit.

6. Press lever switch to DISCH position. Observe movement of the meter pointer for its maximum swing past the value indicated in the discharge column of the tables. If the required needle swing is obtained, it shows adequate charge-holding ability, and the capacitor may be considered good.

As an example of operation, let us take a good 20-μf 150-volt capacitor. After making the necessary connections, set the selector switch of the unit to position 3 (150 volts) and the meter range to 120 ma. When the lever is pressed to CHGE (charge), the meter pointer swings over for the forming and charging current and then quickly stabilizes at a low value. With the meter range reduced to 12 ma, the reading is still low. When the meter range is further reduced to 1.2 ma, the leakage current can be read as, say, 1 ma, which is much less than the allowable 0.2 ma per μf (4 ma in this instance). Return the lever to its neutral (center) position. With the meter range now set at 300 volts a.c., press the lever to DISCH. The meter pointer swings past the half-scale reading required and the test is completed. (The flashing of the neon is incidental but it may be used by noting its duration, especially if a quantity of 20-μf 150-volt capacitors are to be checked.)

The test tables may be made more detailed by adding specific good–bad values for commonly used sizes of capacitors, in much the same manner as in a good–bad tube-testing chart.

Further development versions

For construction purposes, the capacitor tester has been presented here in a form that may be conveniently built for use with the most commonly available meters such as the Precision model 85. The usefulness of the tester may be further developed by greater compactness and use with a v.t.v.m.

One version of the miniaturized unit is shown in the photo: the components have been fitted into a box small enough to become a permanent addition to the multimeter. The small size is made possible by using a Switchcraft type miniature switch and dual-section common-negative can type of electrolytic. The temperature rise of the selenium rectifiers is small enough to be neglected, permitting the close placement of components. An Alden miniaturized pilot light and neon lamp would save still more room.

Extension of the range to smaller capacitor values by the use of a v.t.v.m. as indicator is indicated in the last items of the test table. The test results for capacitors between .001 and .009 μf are given first for the multimeter and then repeated for the v.t.v.m. The v.t.v.m. is a Heathkit V-6 model, having an input impedance of 11 megohms, as compared to the 20,000-ohms-per-volt type multimeter impedance of 6 megohms on its 300-volt d.c. range. What is more important, the v.t.v.m. (on its 150-volt d.c. range) gives a current sensitivity for leakage measurements many times as sensitive as the approximate 1-μa-per-division sensitivity of the multimeter on its d.c. voltmeter range.

The v.t.v.m. will give, not only a more sensitive leakage indication (desirable for mica and ceramic capacitors), but also a much larger pointer swing on charge and discharge tests, when the pointer swing becomes too small for good readings. The v.t.v.m. range scale (of the Heathkit meter) can be successively reduced from 150 volts d.c. down to 50, 15, 5 and 1.5 to handle smaller capacitor values. These more sensitive ranges must be used with proper care, switching them in only when the higher range gives too small a deflection. END

Parts list for capacitor tester

Resistors: 1—27, 2—5,600, 2—39,000, 1—220,000 ohms, ½ watt; 2—2,200, 1—10,000 ohms, 1 watt.

Miscellaneous: 3—20-µf 450-volt electrolytic capacitor (Astron MM 20-450 or equivalent); 1—s.p.s.t. switch; 1—d.p.d.t. switch (neutral center position); 1—2-pole 6-position rotary switch (Mallory 3226 J or equivalent); 1—dial plate for rotary switch; 1—isolation transformer, 10 watts, 120 volts to 120 volts (Stancor PS-8415 or equivalent); 3—selenium rectifiers, 65 ma, approximately ½-inch cube (International Rectifier Corp.); 4—pin jacks; 1—line cord (removable, TV type); 2—jumper leads with phone-tip plugs, 6-inches or longer; 1—NE51 lamp and holder, for discharge; 1—chassis.

Miniature tester mounted on meter.

TEST TABLE I—ELECTROLYTICS

CHARGE TEST				DISCHARGE TEST	
D.C.W.V.	Sw Pos.	Meter Range[1] (ma)	Allowable Leakage[2] (for 20-µf unit)	Meter Range	Allowable Indication (for 20-µf unit)
450	5	Start at 120	4 ma (0.2 ma/µf)	12 ma	6 ma (past ½ scale)
300	4	Start at 120	2 ma (0.1 ma/µf)	300 v.a.c.	200 v (past ⅔ scale)
150	3	Start at 12	1 ma (0.05 ma/µf)	300 v.a.c.	150 v (past ½ scale)
50	2	Start at 12	0.5 ma (.025 ma/µf)	60 v.a.c.	30 v (past ½ scale)
25	1	Start at 12	0.5 ma (.025 ma/µf)	60 v.a.c.	15 v (past ¼ scale)

For meters with d.c. resistance of 20,000 and a.c. resistance of 1,000 ohms per volt

[1]After charging (or forming) surge, reduce range to lowest safe scale for accurate stabilized reading.
[2]Allowable leakage for practical replacement purposes.
[These values are about twice the RETMA standard for new capacitors given by the formula: Leakage current = (factor × µf + 0.3) ma. Factor varies from .01 at 25 volts to .04 at 450 volts.]

TEST TABLE II—NONELECTROLYTICS

			CHARGE TEST		DISCHARGE TEST	
Sw Pos.	Capacitance (µf)	Voltage	Meter Range (volts d.c.)	Allowable Leakage[2] (meter divisions[1])	Meter Range (volts d.c.)	Allowable Indication (approx. pointer swing[3])
5	1 or over	600 400	1,200	Below 6 " 10	1,200	⅔ scale
5	0.5–0.9	600 400	1,200	Below 4 " 7	1,200	½ scale
5	0.1–0.4	600 400	1,200	Below 2 " 4	1,200	⅓ scale
5	0.5–0.9	600 400	300	Below 2 " 4	300	⅔ scale
5	.01–.04	600 400	300	Below 2 " 4	300	⅓ scale
5	.001–.009	600 400	300	Below 1 " 2	300	1/12 scale
5	.005–.009	600 400	150 (v.t.v.m.)	Below 2 " 4	150 (v.t.v.m.)	⅓ scale
5	.001–.004	600 400	150 (v.t.v.m.)	Below 2 " 4	150 (v.t.v.m.)	¼ scale

(Based on resistances of 20,000 ohms per volt d.c. and 1,000 ohms per volt a.c., except where v.t.v.m. is indicated)

[1]Each division on 20,000-ohm voltmeter equals 50 µa divided by number of divisions.

[2]For critical applications such as coupling capacitors, reading should be practically zero and definitely less than 1µa. All indications are for stabilized readings.

[3]Discharge swing should be approximately equal to charge swing. For comparing swings be sure to obtain full swing of each, using lever action, repeated if necessary. Exact readings are not necessary—appreciable difference will be noted with bad capacitor.

The polariscope produces color patterns similar to those shown on our front cover.

STRAIN in VACUUM TUBES

Tube manufacturers check the glass envelopes of tubes to assure strength and long life

By VINCENT C. De MARIA*

THE residual stresses in an evacuated electron tube envelope are of major concern to tube manufacturers. Any strain weakens the glass and makes it more liable to failure when treated roughly, as when inserting or removing the tube, subjecting it to blows or friction or even to the expansion and contraction due to temperature changes in the equipment.

Strains in glassware can be observed with a polariscope, the instrument used to produce the photograph shown on the front cover. It consists essentially of a light source, two Polaroid films with optical axes at right angles to each other and a tinted plate for imparting color. The photograph on this page shows a technician checking for strains in the neck of an experimental cathode-ray tube. Strains are seen as color patterns and give an approximation of the amount of stress. The polariscope indicates the nature of the strain forces, either tensile or compressive, by hues comparable in beauty to nature's rainbow.

In the ever-continuing search for means of reducing strain, alloys have been developed[1] for glass-to-metal seals in which both glass and metal contract at the same rate when cooled from the high temperatures of the manufacturing and sealing processes. Electronically controlled annealing furnaces further relieve the stresses created during manufacturing. The recent application of strain gauges[2] to obtain strain data further aids in providing larger and safer cathode-ray tubes.

Television technicians and others responsible for the placing or mounting of electron tubes play an important role in maintaining stress-free, and therefore long tube life, conditions. Many cases of glass envelope failure in sealed tubes have been due to failure to follow established precautions:

1. When fastening vacuum tubes by the glass envelope, as is often done with picture tubes, a resilient rubber or felt material should be used between the metal mounting bracket and the glass tube envelope.

2. Surface abrasion should be prevented—it weakens the glass structure appreciably. Surface scratches may be caused by placing cathode-ray tubes on a table top or other hard surface without a compressible material between the tube face and table. Other causes of surface abrasion are adjusting ion-trap magnets and inserting tubes in cramped locations while wearing hard gem rings, and storing spare tubes in bulk without their protective cartons.

3. Any leverage effect which results in tensile forces must be eliminated. Such forces are produced when pressure is applied at the neck or base of a securely mounted tube when adjusting or mounting deflection yokes, focusing coils or magnets and ion traps.

Do not conclude from the above that all strains in glass are harmful. Strain has its brighter side and is often introduced intentionally under controlled conditions. Mechanical strength and resistance to thermal shock are increased when the surface of glass is placed in compression. This so-called tempered glass is used in rear-view automobile windows, glass doors and some airplane windshields.

The electronics industry takes advantage of controlled stresses in fabricating the tube presses (stems) which contain the wires that support the electronic elements. By properly adjusting the annealing cycle, strains are left in the glass and can be seen when viewed in the polariscope at room temperature. When the tube is operated at high temperatures, reverse forces are created and the glass stem becomes stress-relieved.

The colors seen in the polariscope are among the most valuable aids in detecting and correcting harmful strain patterns. The manufacturers' efforts toward eliminating weakening factors, plus proper handling by those responsible for installation, will go far to provide safe and economical operation of electron tubes. END

*Sylvania Electric Products Inc., Bayside, N. Y.

References

[1]U. S. Patent 2,371,627.

[2]A. Cohen and R. F. Doran "The Use of Strain Gauges for Determining the Pressure-Strain Relationship in Television Envelopes," *Bulletin of the American Ceramic Society*, Vol. 33, page 1, January 1954.

SCANNING WITH ULTRASOUND

By S. M. MILANOWSKI

A fascinating application of sound energy

ULTRASONIC scanning techniques are among the most important methods of locating hidden flaws in materials such as brass, steel, aluminum, plastics and ceramics—many of which could not be satisfactorily tested with X-rays or other means.

Some engineers still maintain that ultrasonic scanning will eventually become a standard feature of all television receivers, since light modulated by ultrasound produces exceptionally sharp and bright images. But they also agree that such scanning will not become completely practical until present television systems have been greatly simplified.

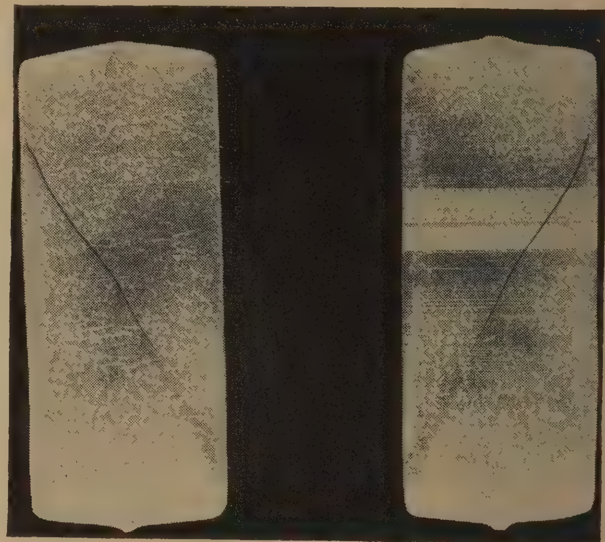
Initial efforts to use ultrasound for industrial test purposes in both the United States and Europe consisted of projecting high-frequency vibrations from a transducer through a material, to a receiving device—much the same as X-rays are used. This was an effective method of testing relatively thin sheet or plate materials, because the intensity of ultrasonic vibrations penetrating a material is proportional to the density (and thus the quality) of the material.

It was not a practical method of testing most materials because sonic impulses traveling from one medium into another have a tendency to become echoes and thus lose their ability to penetrate. For example, if an ultrasonic impulse is sent through a heavy forging, much of the energy of the impulse will be lost when:

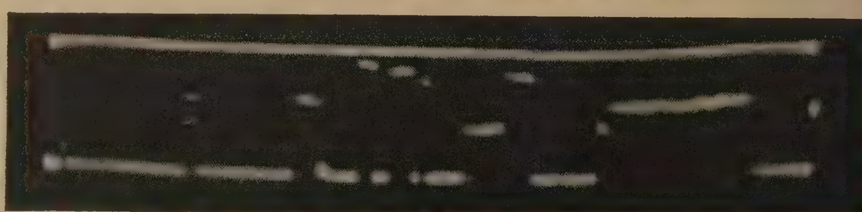
1. The surface of the forging that is closest to the transducer or generator produces an echo.
2. Flaws of foreign matter, if any, within the forging produce echoes.
3. The surface of the forging farthest away from the transducer or generator produces an echo.

Industrial engineers soon began to investigate the possibility of using ultrasonic echoes to determine the presence or absence of flaws in various industrial materials. This was a difficult task, despite the fact that ultrasonic echo devices had been used as depth finders aboard vessels since about 1912, and much had to be learned about the acoustical properties of numerous materials.

The first industrially practical echo test devices were developed almost simultaneously in England, Germany and the United States during World War II. Most of these were similar to, if not precisely the same as, the *Ultrasonic Reflectoscope* produced by Sperry Products, Inc., Danbury, Conn.



Ultrasonic equipment indicated crack in specimen and was sustained when specimen was cut. X-rays did not show flaw.



Scanning image. Long white line represents upper surface of material. Dots and lines beneath it indicate flaws.

This instrument generates ultrasonic impulses by using radio-frequency current to vibrate a piezoelectric crystal (usually a quartz crystal, although barium titanate crystals have been used). Impulses with frequencies of 1 mc or more are commonly used, since echoes of maximum intensity cannot be produced with ultrasounds at lower frequencies. The exact frequency used in any given circumstance depends on the ability of a test material to pass a sonic impulse with maximum efficiency: no two different materials have the same acoustical properties.

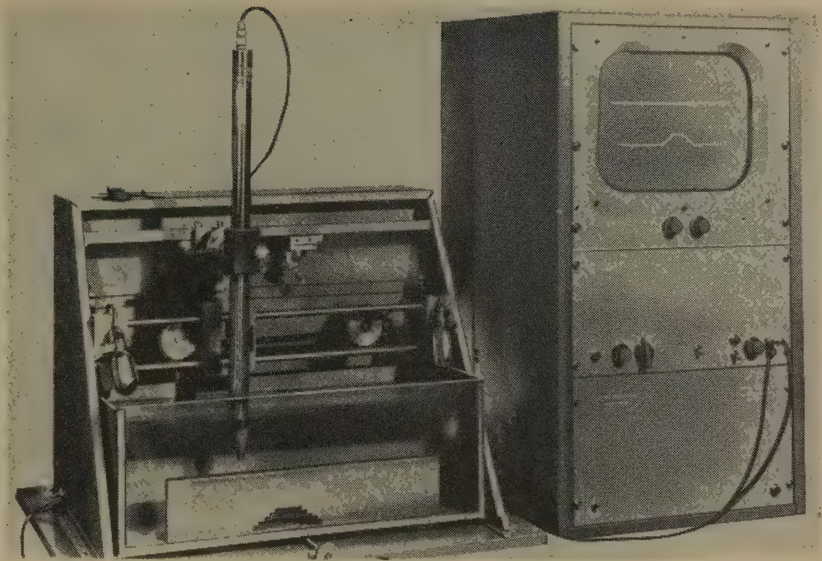
The metal holder for the Reflectoscope's output crystal is usually held in close contact with the surface of a material to be inspected because high-frequency ultrasound will not penetrate the thinnest layer of air. However, the need for close contact between the crystal and a test specimen has been eliminated in many cases by immersing both units in a fluid such as water.

After the energy from each ultrasonic impulse is reflected, the output crystal of the Reflectoscope serves as a detector, making it possible to amplify each echo and produce visual signals on the face of a C-R tube. The positions of the signals or visual images on the face of the tube vary with the amount of time required to produce different echoes.

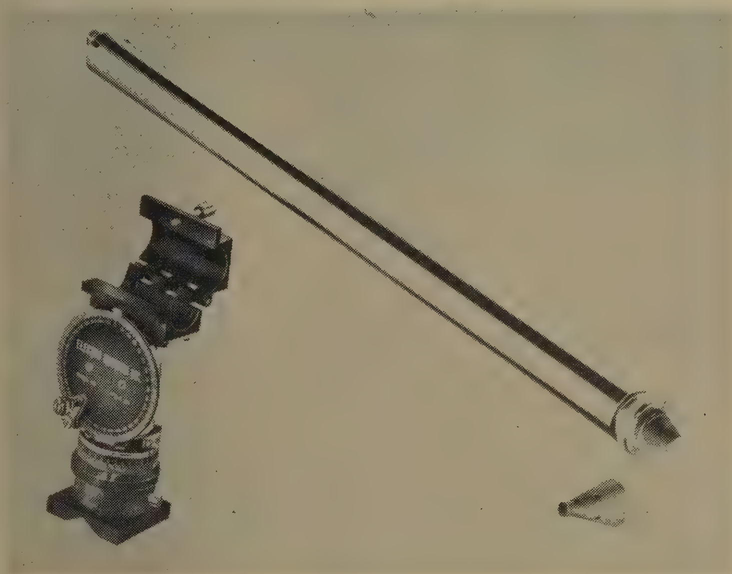
Therefore, signals on the extreme right or left side of the tube indicate nothing more than the existence of two material surfaces; images near the center of the tube indicate internal flaws.

Devices of the Reflectoscope type have saved millions of dollars for railways and airlines during recent years by locating small flaws in rails, axles, crankshafts and other components whose failure could cause serious accidents. Similar defects couldn't have been detected with X-rays in most cases because they were either too small to vary the density of X-ray pictures or they existed in materials such as lead and brass alloys which cannot be penetrated by X-rays.

Yet, for many industrial purposes, ultrasonic instruments had one serious shortcoming: They couldn't be used to distinguish small, unimportant flaws



Material immersed in tank is scanned, the image appearing on the C-R tube screen.



Components of search unit. Quartz crystal is mounted on right-hand end of long metal tube. Cone-shaped unit fits over tube and beams ultrasound. Remaining parts used to align tube and material.

from the major defects which can cause some articles to be virtually useless.

This shortcoming has now been eliminated by a television type scanning technique that makes it possible to observe on a C-R tube a complete cross-sectional image of a test specimen—a view that could otherwise be obtained only if the specimen were cut into two pieces. This technique was originated by Electro-Circuits, Inc., Pasadena, Calif., but similar methods have recently been developed by other firms producing ultrasonic test instruments.

An ultrasonic search unit is moved over the surfaces of a material specimen so that as many as 1,000 energy impulses per second can be echoed, amplified and indicated on a C-R tube screen. A phosphor coating on the screen causes the visual signals to glow for many seconds after they are produced.

As a rule, both the output end of the search unit and the test specimen are immersed in a water-filled tank so that ultrasonic impulses and echoes can be transmitted and received without running the risk of damaging a thin quartz crystal by rubbing it over a rough-surfaced test specimen. Where an immersion tank is impractical, as in testing underground gas pipes for corrosion, special fixtures transmit the ultrasonic impulses to the surfaces of test specimens through a stream of running water.

As much as 90% of the energy transmitted by the search unit is echoed when it comes in contact with the nearest surface of the test specimen. This produces an intense reference line which indicates the relative position of that surface on the C-R tube screen.

Energy entering the test specimen is echoed either by flaws or the farthest surface, and the visual images produced on the screen indicate the precise shape and locations of flaws below the specimen surfaces.

Scanning movements of the ultrasonic search unit can be produced by either manual or mechanical means, and the position of the search unit can be varied to beam energy at a specimen from different angles. "Angular beaming" is essential to the accurate evaluation of many flaws. For instance, an internal crack which appears to have pinpoint dimensions if it is viewed from one end may turn out to be a serious flaw when scanned from a different angle.

The images produced by rapid scanning may be either larger or smaller than the details of a specimen or area being tested, since their size can be controlled by a potentiometer mechanically coupled to the search unit.

Thus, if the potentiometer is properly adjusted, the cross-sectional details of a test specimen with a length of many feet can be compressed and viewed on a 16-inch screen. Or, the cross-sectional details of a very small specimen or limited test area can be magnified so that the most minute flaws can be easily observed.

Ultrasonic test methods will probably never replace X-ray testing techniques, since gamma radiations can be used to locate flaws in many materials with nonuniform composition—for example, in extremely porous castings and plastic laminates which would cause ultrasonic testing devices to produce a confusing variety of echoes and visual signals. However, ultrasonic techniques do appear to represent the least expensive and most effective means yet devised for the location of internal flaws in materials with uniform compositions.

It is worth noting that, while intense sound waves can be destructive, energy impulses that won't penetrate the thinnest layer of air create nothing remotely comparable to a radiation hazard. In fact, ultrasounds of the types used for test purposes have an established therapeutical value. And, according to recent report from researchers at the Massachusetts Institute of Technology and the University of Minnesota, they may soon be widely used to supplement X-rays for the accurate diagnosis of many internal diseases, including cancer types, which could not heretofore be identified without surgery. END

New techniques in

electroencephalography

the recording of brain responses

By F. J. G. van den BOSCH

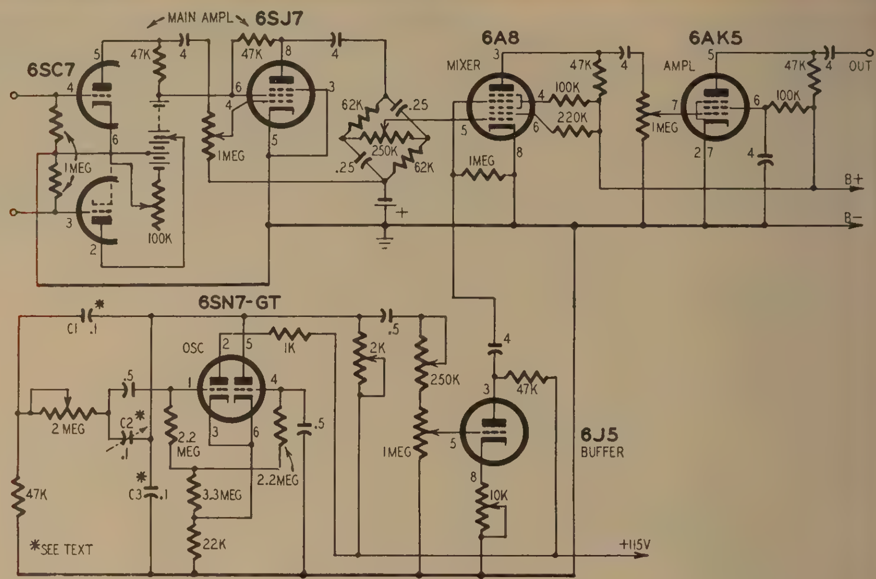


Fig. 1—Schematic of instrument used in beat-frequency technique experiments.

THREE years ago I suggested several new approaches to electroencephalograph (EEG) technique. One that I used with success in certain of my experiments is the beat-frequency technique—the circuit is shown in Fig. 1. It consists of the well-known Toennies input circuit, using a 6SC7 selected for low input noise and grid current. It is followed by a single 6SJ7, followed by a bridge system of the type used by Mr. Grey Walter. The output of the bridge is fed into the control grid of a pentagrid converter (a 6A8 has been found suitable). On grid 4 of this tube is injected the oscillator voltage.

The oscillator is a 6SN7-GT in a resistance–capacitance circuit. Its frequency can be varied by changing the value of C1, C2 and C3. I have found that the required frequencies (2 to 50 cycles) can be covered by using a variable capacitor for C2.

The oscillator tube is followed by a 6J5 buffer stage. The pentagrid stage is followed by a 6AK5 amplifier before being applied to the oscilloscope or a pen recorder. Wave analysis is very much simplified and can be made almost instantaneously if visual observation is sufficient; otherwise photographic records will show clearly in-phase signals as compared with other frequencies. I recommend this procedure strongly to anyone wanting to start in EEG. Compared with complicated wave-analysis apparatus, it simplifies matters very much and has enabled me to study the relative efficiency of different types of electrodes.

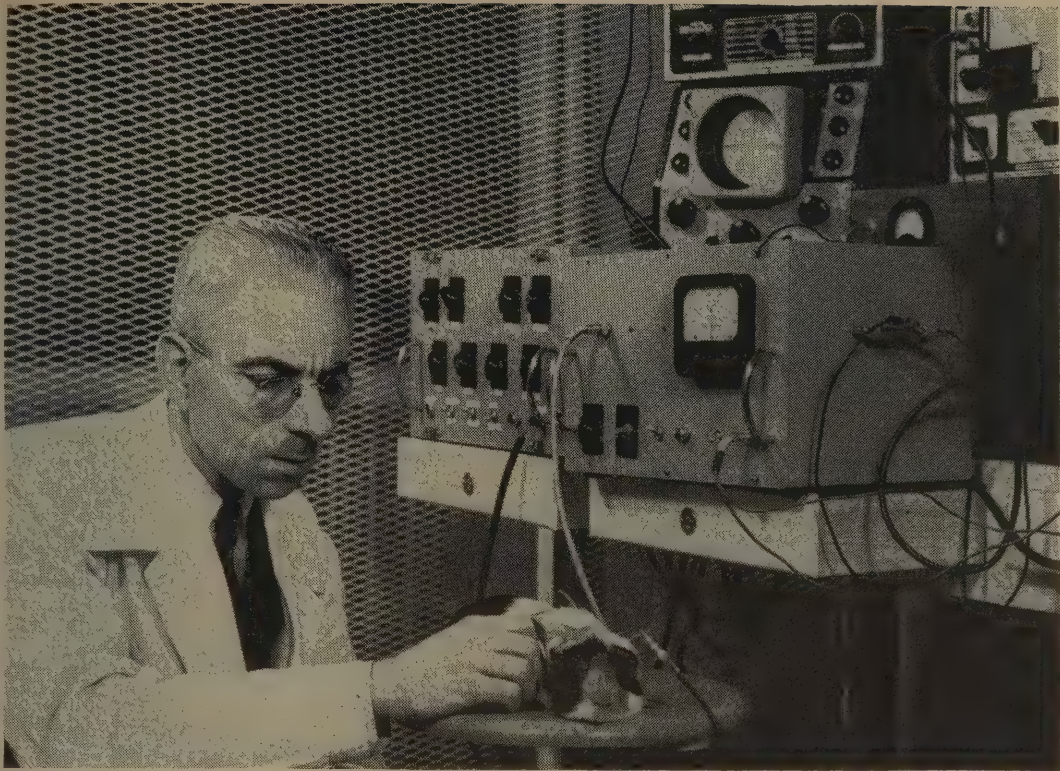
Let me remind the reader that these recordings (EEG) are made by applying to the scalp several small electrodes soaked in a saline solution. The potential difference between two electrodes is then recorded. The value of this potential can differ greatly, and practitioners have agreed on certain positions for the electrodes so that potential differences measured might be interpreted uniformly. The recordings have thus acquired a clinical significance. It has been possible to diagnose with certainty several diseases of the brain as well as identify and localize brain tumors.

EEG may still be considered in its infancy. Though it is proving of great assistance to the medical profession, it is—from the physicist's point of view—a very rudimentary method of ascertaining the electrical functioning of the brain.

Let us look at the input circuit. Fig. 2-a shows the method of applying electrodes to the head, Fig. 2-b is the equivalent circuit. Capacitors C1 and C2 are very small. Resistor R2 is the skin resistance between electrodes (they are in saline solution) and is usually between 5,000 and 15,000 ohms. When we consider the frequencies, the network is very inefficient. The electrodes applied to the head have a capacitance ranging from 1 to about 5 $\mu\mu f$. This is of course an average, for the value varies from individual to individual and is governed by a series of factors outside the reach of either the physicist or neurologist (thickness of the skull, temperature of the tissues, etc.). I have found variations from 2 to 6.2 in the dielectric constant. The virtual surface of the electrodes is also subject to slight variations. The same can be said of the resistance of R1, which is constituted by the neurons. But even with such an inefficient network, voltages averaging 50 microvolts are recorded.

The most commonly used system of recording EEG is by the potential gradient method, the voltages being recorded between two electrodes situated on the head. This is no doubt a very efficient and easy method for locating brain tumors. Another method of recording EEG potentials consists of taking the potential between one electrode on the head and one attached to an ear lobe as a reference electrode. I believe this method, when properly developed, should yield better results.

For some of these experiments I have used a double-tetrode electrometer tube manufactured in England by Ferranti (type DBM12A) as a separate preamplifier.* Electronically speaking, it can better be considered as an impedance conversion device. The tube lends itself to the same applications as the American FP54, though this is a single tetrode. Fig. 3 shows this tube in the Dubridge-Brown circuit, which gives excellent results. Beginners should guard against temperature fluctuations which might influence readings. The circuit as shown together with the Ayrton shunt and galvanom-



Author conducts an experiment in electroencephalography in his laboratory.

eter constitutes an excellent control apparatus. It is also recommended to physiologists who are interested in a single recording only.

Great progress has been made in the last few years in medical science in the anatomical, pathological, biochemical and surgical fields. What in my view has been left too far behind is the purely physical aspect. When a patient dies from an unknown cause, the anatomist may look to the pathologist to tell what happened. But cell structure alone (and these are *dead* cells) will not solve the riddle completely. I am sure that on the day when all the physical parameters are added to the normal medical diagnosis, medical science will really progress.

To enlarge the point a bit further, let us consider the human body a moment purely from the physical aspect. It can be considered a vast communications network with the brain as a kind of central and upper governor. Let us consider—for example—a pinprick in the hand: Immediately a train of pulses is sent to the brain, which interprets this message and sends out another train of pulses, apparently similar to the first, but with the result that there is an immediate withdrawal of the hand. If at the same moment the foot gets a comfortable feeling of warmth, the train of pulses will be interpreted differently.

Anatomists and neurologists tell us that the brain is a very complicated mechanism and that various centers deal with specific functions and that certain nerve fibers conduct only certain impulses. This does not take away the physical fact that the brain is able to detect, using the methods of frequency discrimination, pulse height and pulse modulation. That is, it is able to compare certain voltages and to ascribe to those voltages specific functions, and in accordance with this, set in motion messages traveling along nerves, resulting in the control of muscles or glands.

If certain nerve fibers conduct only certain pulses, it is probably due entirely to the perfect matching networks these nerves possess to convey the particular messages. I suggest here that the modulation carried by nerve pulses most nearly approaches the coded-pulse type of modulation; a suitable oscilloscope display will show this. The average potential of such messages is in the order of several millivolts. This potential is produced by the central nervous system. When recording EEG with potentials of, say, 50 microvolts, a great loss must occur somewhere. In the interest of progress I hope someone will soon produce a new approach to the recording of EEG potentials, without having to use the corto-encephalographical method (recording direct from the exposed brain). Electronics is bound to find the correct answer to this problem in time. END

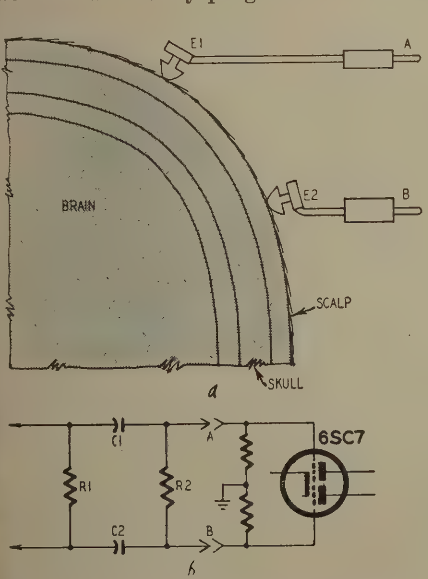


Fig. 2—Actual and equivalent circuits for applying electrodes to the head.

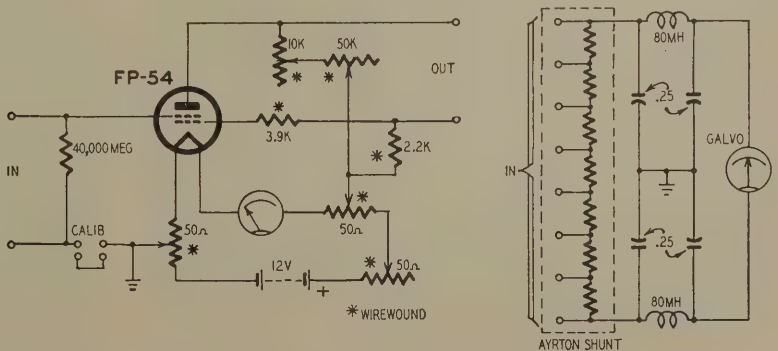


Fig. 3—The Dubridge-Brown circuit with the Ayrton shunt and galvanometer.

AIEE GOES ELECTRONIC

By FRED SHUNAMAN
Managing Editor

THE 1955 Winter General Meeting of the American Institute of Electrical Engineers—held in New York Jan. 31–Feb. 1—witnessed further advances of electronics into the field of electricity. Television was the subject of one of the sessions; others discussed semiconductors. Transistor time-delay circuits and transistor demodulators for magnetic amplifiers were among other subjects covered, as was a paper on calculating the voltage gain of a resonant dielectric amplifier.

One paper dealt with an all-magnetic audio amplifier system. The amplifier is powered with an a.c. supply at 10,800 cycles, permitting amplification of signals from 90 to 3,000 cycles. The supply is obtained from a three-phase, 400-cycle line by three cascaded frequency triplers. Power output is about 2.5 watts. The audio range could have been extended upward if desired by using a higher-frequency supply.

Two of the most important developments presented to the meeting were revealed by General Sarnoff of RCA in an introductory speech. These were an electronic tone synthesizer and an electronic cooler or refrigerator. The tone synthesizer was discussed in greater detail at a later session by Dr. Harry F. Olson, who developed it. General Sarnoff also referred to RCA's recent work in recording television programs and developing a light amplifier.

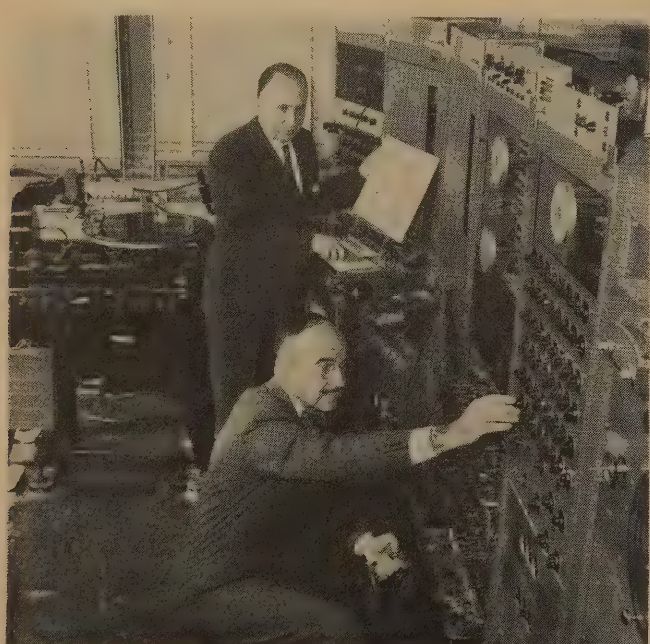
The tone synthesizer works on the principle that a tone can be analyzed into its various characteristics: frequency or pitch, amplitude, attack or growth, duration, decay, waveform or timbre, frequency and amplitude modulation (vibrato and tremolo) and abruptness or gradualness of transition from one note to another. It is then possible to construct a device consisting of oscillators, filters, amplifiers and trees of relays which can reproduce any tone exactly, or produce tones like those of no presently known instrument.

The work of breaking a piece of music into its various components is slow and laborious. Once accomplished, however, the results can be placed on a perforated paper roll vaguely resembling that of an old-time player piano and reproduced as often as desired. One of the main uses of the instrument, according to Dr. Olsen, is to make phonograph records.

The electronic refrigerator is the work of Nils E. Lindenblad of the RCA Laboratories. Its principle is an old one—discovered by Peltier more than 120 years ago. When current is passed through the junction of certain dissimilar metals (such as copper and bismuth), the junction absorbs heat. For years attempts have been made to put the effect to practical use, but with little success. The RCA scientists point out that—unlike earlier workers—they had the advantage of new knowledge provided by recent studies in solid-state physics. With new alloys they have been able to achieve usable temperature drops and feel that "our continuing quest for improved materials so far has discovered no indication that a limit has been reached."

Bell Laboratories presented a computer type device called the "outguesser." It utilizes a person's (or machine's) past performance to predict future actions. Limited at present to playing a game much like coin-matching, it may find practical applications in the development of future phone systems.

Another possibly more interesting, though less serious, device exhibited by Bell, was "Little Audrey," a machine that plays a version of the "take a number" game. The machine is intended to demonstrate what the telephone company can do with relays. Little Audrey understands three words, "yes," "no" and "O.K." spoken into a microphone, and communicates with the world by flashing words on a screen. The operator mentally selects a number from 1 to 8, then answers a number of questions asked by the machine, which always guesses the correct number. According to the scientists who developed it, Little Audrey can play the game with more finesse than any human player because she can hold a number of computations in her "memory" (composed of relays) that no human being could carry in his head. END


Tone synthesizer—Dr. Olson at keyboard, H. Belar at controls.

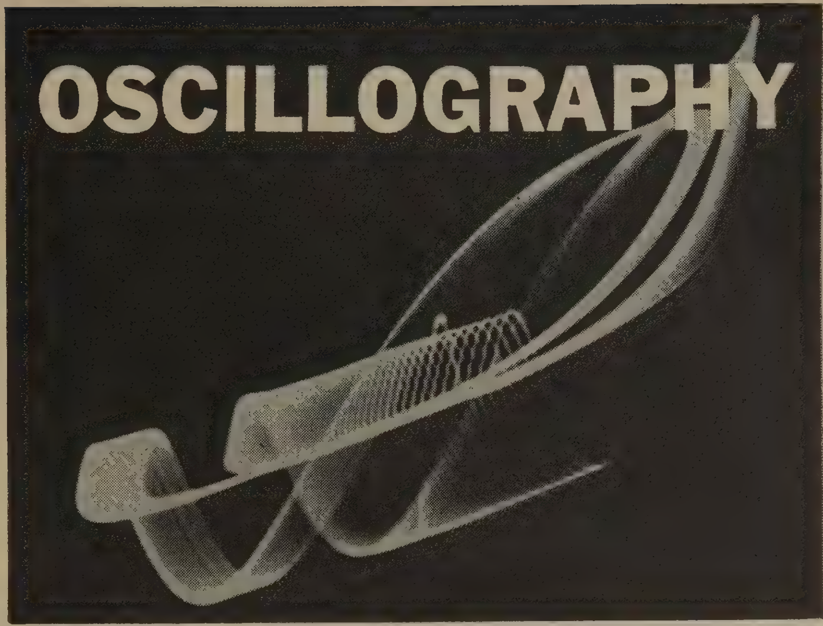

Nils Lindenblad shows Peltier elements in electronic cooler.

ABSTRACT OSCILLOGRAPHY

MORE than one technician has been fascinated by the patterns that can be obtained on his oscilloscope and has juggled the controls to bring in more interesting and intricate Lissajous figures. Some scope patterns have occasionally been printed for their beauty alone. It has remained for an Iowa experimenter to create a whole group of *Electronic Abstractions*, composed of sine, square and sawtooth waves, combined in various ways and with the help of phase splitters, amplifiers and distorting devices.

Mr. Ben Laposky of Cherokee, Iowa, is the electronic artist who produced the designs on this page as well as a multitude of others. Those shown here are among the simpler ones in his collection, which includes many remarkably delicate figures, numbers of striking three-dimensional effects, and some patterns very reminiscent of natural figures such as butterflies and ballet dancers.

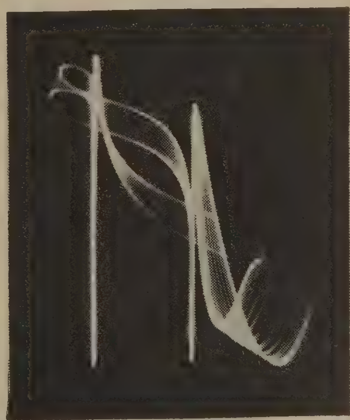
More than 30 electronic instruments of various types, especially constructed or modified for the work, were used by Mr. Laposky to produce his collection of nearly 6,000 photographed designs. These *oscilloins*, or electronic art forms, have been exhibited in more than a dozen art galleries and museums throughout the United States. END

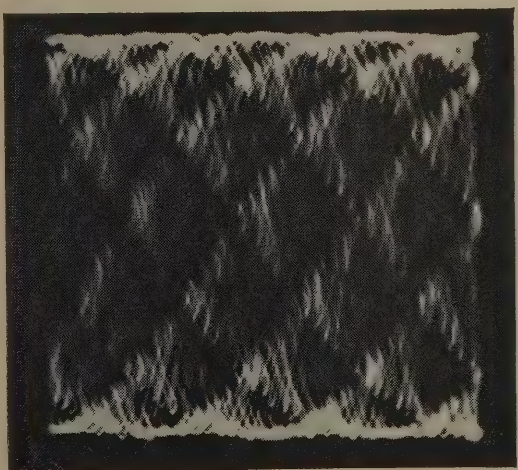


The above pattern was made by sine-wave generators connected to the H and V terminals through a phase-splitting network and another one connected directly across the H and V terminals.

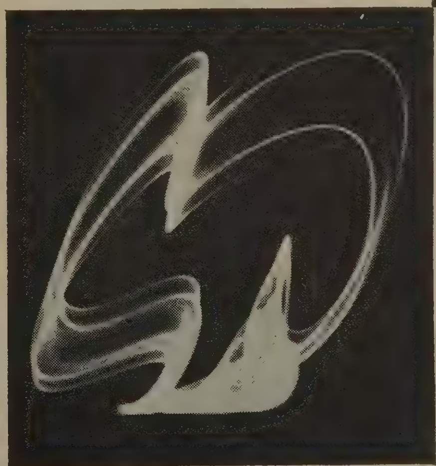
Sine-wave generator to scope through a phase-splitting network modulated by another across part of the phasing net.

Two sine-wave generators, an electronic switch and a phasing network produced this pattern.

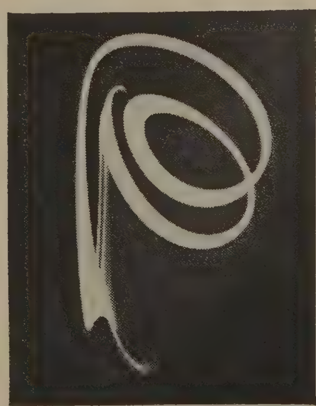




This is made by a sine wave to scope, with modulation by a sawtooth wave.



This is a sine wave through a circular amplifier, modulated by another sine wave.



Two sawtooth generators in series through phase-splitting network.

Intercarrier BUZ-Z-Z-Z-Z-Z-Z

Various causes and cures for this common trouble

By ROBERT G. MIDDLETON*

THE intensity of 60-cycle sync buzz from the sound channel of an intercarrier receiver usually increases to a maximum when the picture and sound carriers are placed at equal heights on the response curve (Fig. 1). Incorrect placement of the carriers is usually caused by incorrect adjustment of the local oscillator, but may also be caused by incorrect alignment of the signal circuits at excessive bandwidth or mistuning of sound traps.

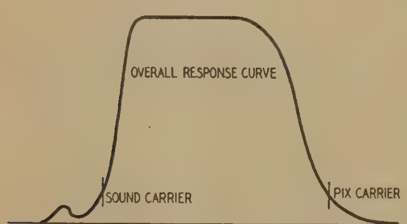


Fig. 1—Picture and sound carriers are incorrectly set at equal heights.

Even when the carriers are properly placed on the response curve, with the picture carrier at a point 6 db down from the top of the curve and the sound carrier 20 db down, nonlinear amplification of the TV signal causes cross-modulation of the picture and sound signals. This generates unwanted voltages, some of which are recognized as sync buzz in the sound.

A d.c. scope should be used to determine whether the residual picture carrier is being limited or clipped. It must be connected at the output of the picture detector if the video amplifier is a.c. coupled. If the video amplifier is d.c. coupled, the d.c. scope may be connected at the output of the video amplifier.

As shown in Fig. 2, the video signal rises above the zero-volt line on the d.c. scope screen, showing the amount of residual picture carrier present.

Except during test-pattern time, when the transmitter is being adjusted or during switching operations at the transmitter, the maximum picture modulation is 85%, leaving a margin of 15% of unmodulated picture carrier present at all times to produce proper heterodyning of the sound and picture signals in the i.f. amplifier and picture detector, for developing a buzz-free 4.5-mc sound signal.

Nonlinearity in single-ended r.f. amplifiers almost invariably produces sync-pulse compression (Fig. 3) without affecting the residual picture carrier. However, double-ended r.f. amplifiers in distribution systems and similar arrangements will occasionally develop residual carrier compression. The presence of this distortion can be checked easily with a d.c. scope.

The appearance of sync buzz in the sound (Fig. 4) when the video signal is completely unaffected and only the sync tips are clipped or compressed may seem strange. But, when a sync tip is clipped, the video carrier is being clipped. During the clipping interval cross-modulation of the sound signal and picture carrier takes place, generating harmonics and sum-and-difference frequencies. The difference frequencies are heard as 60-cycle sync buzz in the sound channel.

Nonlinearity in the r.f. and i.f. amplifiers is usually caused by low a.g.c. voltage, permitting grids to be overdriven. However, other incorrect operating voltages, such as low plate and screen voltages, can cause nonlinear operation even when the grid bias is correct. Likewise, a weak tube can cause this type of sync buzz.

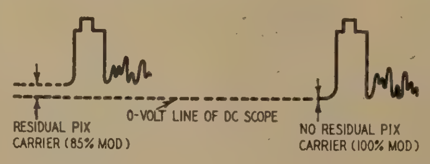


Fig. 2—Video pattern on d.c. scope.

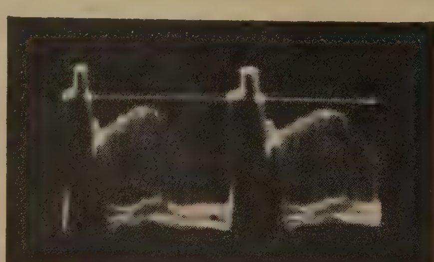


Fig. 3—Sync-tip compression pattern.

When the signal levels on various active channels differ widely, buzz may be heard when receiving a strong signal but disappear when receiving a weak one. Likewise, picture distortion may accompany the sync buzz when a strong signal is being received but disappear on a weak signal, because the nonlinearity of a stage is usually reduced when the grid drive is reduced. In some cases the buzz level becomes annoying only when a weak signal is being received. One of the reasons for this is that many intercarrier receivers have a partial limiter ahead of the ratio detector, and limiting action falls off as the signal level is reduced. There is always some buzz modulation in the 4.5-mc sound signal, often sufficient to be audible unless good limiting action is provided ahead of the ratio detector.

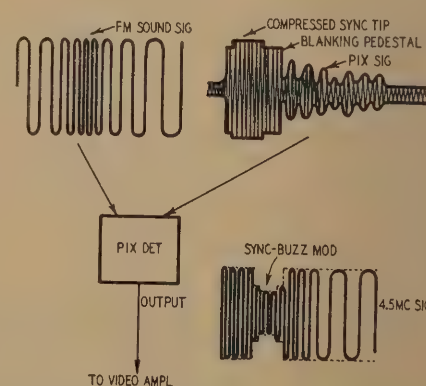


Fig. 4—Producing sync-buzz modulation.

Another reason for buzz increase on weak-signal reception is unbalance in ratio-detector operation — the center frequency of the ratio detector shifts with changing signal level. This un-

* Field Engineer, Simpson Electric Co.

balance can be seen easily with the aid of a sweep generator and marker. As the output from the sweep generator is reduced, the S curve should decrease symmetrically in height and the 4.5-mc marker should remain exactly at the center point of the S curve. Unbalance in ratio detectors is a major problem. Some of the more common causes are: unbalance in the duo-diode tube, defective stabilizing capacitor (single-ended circuits), out-of-tolerance bleeder resistors and ratio capacitors.

In still other cases the signal circuits regenerate at low bias values, causing serious deterioration of both i.f. and ratio-detector response curves during weak-signal reception. Regeneration is an involved problem. However, systematic tests are available for regenerative signal tracing and provide localization of the feedback loop. A feedback loop is always present when regenerative distortion exists. Once the loop is traced out, the search for the fault is narrowed down considerably.

Probes for troubleshooting

Suitable probes must be used with a d.c. scope when checking the 4.5-mc sound signal and when checking amplifiers for shift of the operating point. Two arrangements are shown in Fig. 5.

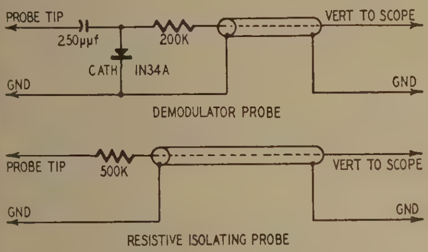


Fig. 5—Probes for checking sync buzz.

The crystal demodulator probe is especially interesting. The output of the demodulator probe has an a.c. and a d.c. component, as shown in Fig. 6. When a demodulator probe is applied in the 4.5-mc signal circuits, the display rises above the zero-volt level by an amount equal to the voltage of the FM sound signal.

The top of the FM sound signal, as seen in Fig. 6, is not uniform, but contains AM components generated by cross-modulation and by slope detection. Chief of these, from the standpoint of buzz troubleshooting, are the 60-cycle buzz pulses, usually appearing as a downward notch in the 4.5-mc signal, as shown. This notch is the stripped vertical sync pulse. Stripping results from passage through narrow-band circuits—in particular, from passage through the demodulator probe output network. When the buzz voltage is higher, the notching is deeper, as shown in Fig. 7. Using the zero-volt level on the screen of the d.c. scope as reference, the percentage of modulation of the 4.5-mc sound signal by the 60-cycle buzz pulse can be found.

A conventional ratio detector can reject about 40% of downward modulation, but higher percentages ride through the ratio-detector circuits and appear in the sound output. Hence, the modulation must be kept below 40% or a limiter must be used ahead of the ratio detector.

The resistive isolating probe (Fig. 5) is useful for checking for shift in operating point. It is used with a d.c. scope and can be applied at the plate of any tube in the signal circuits. The test is made by observing the level of the trace on the scope screen with the antenna connected, and then disconnected, from the receiver. Any shift in the level of the trace indicates a shift of operating point in the amplifier tube; hence nonlinear operation which increases the amount of buzz modulation in the 4.5-mc sound signal.

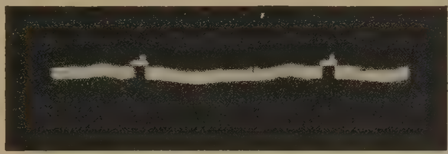


Fig. 6—The demodulator probe output.

Lead-in mismatch buzz

Buzz is sometimes the result of an impedance mismatch between the lead-in and the front end of the receiver. This occurs because the impedance mismatch generates standing waves on the lead-in. These offer a different impedance to the front end at different frequencies, which distorts the response of the receiving system. As a result of this distortion, the sound-carrier voltage may be boosted, while the picture-carrier voltage is attenuated. The heterodyning process through the picture detector then takes place at improper voltage levels and the 4.5-mc beat contains an abnormal amount of vertical-sync modulation.

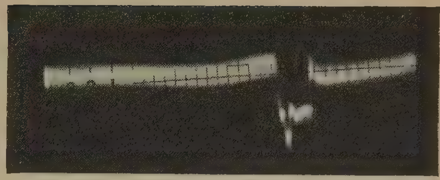


Fig. 7—Deeply notched sound signal.

Discontinuities of the lead-in cause similar trouble. Discontinuities are caused by taping the lead-in to metal pipes, draping the line over metal gutters and running the line under metal window sashes. Mismatch buzz varies in intensity from channel to channel and usually can be heard on only one or two channels; alignment buzz, in most cases, is apparent on all channels.

When the front end is mismatched to the lead-in, various corrective measures are possible. The input impedance of the front end is controlled primarily by the closeness or looseness of coupling of the r.f. grid coil to the antenna coil on the tuner strip. Although such adjustments require knowledge of how to use the scope to determine impedance matches and mismatches, the operation is no more difficult than that of tuned-circuit alignment. It is only the unfamiliarity of impedance adjustment which makes it look hard.

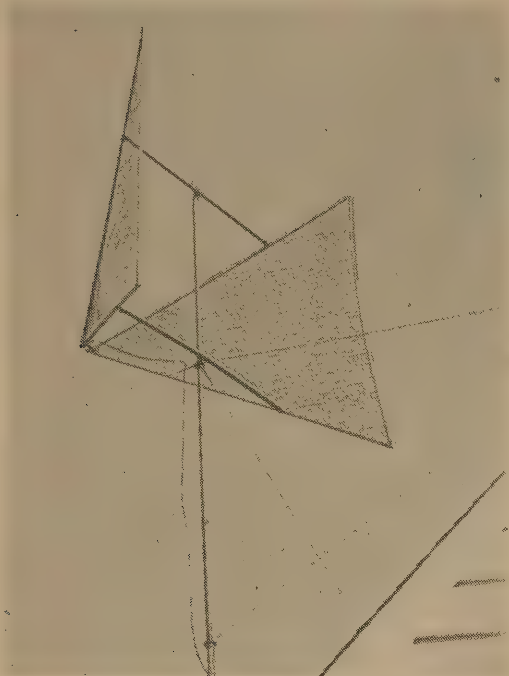
Detailed discussion of these matters will appear in an early issue. END

TELEVISION MASTS OVER RUSSIA

Marguerite Higgins

TV antennas on an apartment house in Zagorsk, 40 miles from Moscow. TV reception in Russia is concentrated in areas within 100 miles of a few large cities.

HORN ANTENNA *construction*



By M. G. O'LEARY

Unit provides excellent u.h.f.—v.h.f. fringe-area reception

AM radio had its advantages. Ordinary wire 20 to 30 feet long would bring in more than enough stations from any direction. In fringe areas TV reception is much more complicated. Aside from boosters, u.h.f. converters, local–fringe switches, etc., the choice of a proper antenna installation is often complex. For example, in Kingston, Ont., one might like to receive:

Channel	Location	Direction	Distance (miles)
9	Toronto	W	150
4	Buffalo	WSW	150
6	Rochester	SW	85
10	Rochester	SW	85
3	Syracuse	S	75
8	Syracuse	S	75

The average family up here beams a couple of Yagis or a broad-band antenna at Syracuse and settles for channels 3 (100 kw) and 8 (200 kw). With this arrangement channel 3 comes in well, channel 8 not as well, despite its extra power. This indicates that it is more difficult to pull in the high-band than the low-band v.h.f. stations in fringe areas. The problem was still more complicated due to our home being in a valley.

What we needed was an antenna reasonably sensitive on the low band, very sensitive on the high band and extremely sensitive for u.h.f. stations. Because of children in the family, we wanted one lead-in. Channel 48 (soon to go on the air) would be tuned by a u.h.f. strip in the turret tuner. At the present stage of the art antenna sensitivity is directly related to directivity —sensitive antennas must be rotated for optimum reception from different directions. I tried to get around this by designing a long-wire type of antenna that, in one position, would be correctly oriented for most or all of the stations listed above. It wouldn't work. I turned to studying the various types of broad-band v.h.f.–u.h.f. antennas.

I couldn't find any antennas that met the sensitivity requirements for u.h.f. as well as v.h.f. However, I did find a technical article describing a type that seemed to do what was needed—an article on horn antennas by Dean O. Morgan in the October, 1951, issue of *Electronics*. This antenna was based on that article. It must be rotated for stations in different directions, but it meets my rather exacting demands in all other respects. We have not had any u.h.f. yet, but are confident that the antenna will pull in channel 48 when it comes.

Antenna design

The "horn" is the shape of a pyramid laid on its side with the top and bottom sides left open (see photo). The two other sides are electrically isolated and feed the transmission line at the apex. All angles are 60°—the sides are equilateral triangles and are flared at 60° from each other. These sides could be built in a number of ways, but it seems most practical to use chicken wire for lightness and low wind resistance.

The sensitivity of the antenna is a function of its mouth size with respect to the wavelength to be received—greater sensitivity for larger size. Gain is directly proportional to direction, and this holds true in practice. On the high band the antenna must be beamed very accurately; on the low band the beaming can be fairly sloppy. Syracuse and Buffalo are some 60–70° apart, yet channel 4 in Buffalo will come in relatively well when the horn is beamed at Syracuse. As a matter of fact, there is a suspicion in my mind that, for channel 3, the antenna just approaches being a huge dipole, as airplane flutter occurs when planes fly to the rear of it. Nevertheless, the picture-pulling power for channels 3 and 4 seems to compare well with other types of fringe antennas.

With a rising-gain–rising-frequency characteristic, one would expect tremendous sensitivity at channel 48. Such would not be desirable in practice, for the tremendous gain would be accompanied by pinpoint directivity. Even if the antenna could be pointed accurately, it could not be held on the beam constantly for such a large structure is sensitive to even the very lightest breeze. Fortunately, there is a simple means of holding down u.h.f. sensitivity to a practical value.

If the mesh spacing of the chicken wire exceeds .05 wavelength, there is loss of sensitivity. At 200 mc, .05 wavelength is approximately 3 inches. At 600 mc, it is 1 inch. The use of 2-inch mesh wire for the antenna with a 36-inch wide strip of 1-inch mesh at the apex should have the effect of an electrical mouth size of 3½–4 feet at 600 mc. This should allow the directivity at channel 48 to be less critical.

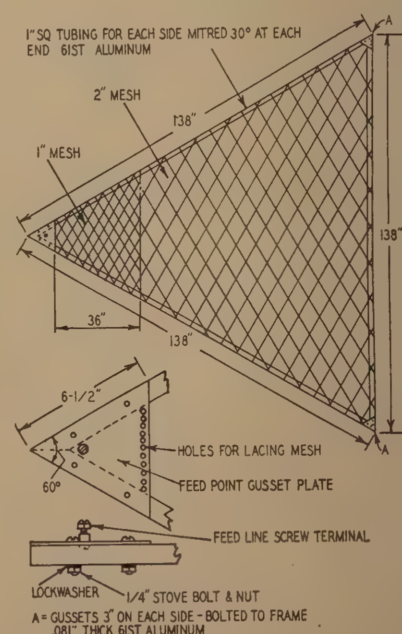


Fig. 1—The sides of the horn antenna.

Some months after his article was published Mr. Morgan wrote in *Electronics* in reply to letters written him by experimenters who had built the horn. Most of these reported excellent results electrically. Mechnically, results were poorer—it was hard to keep the antenna in the air.

You can't appreciate the size of an 11½-foot horn antenna until it is erected. Mine has become almost a landmark. When first put up 6 months ago, it was not only a curiosity, but also the butt of many nasty predictions of what would happen come the first blow. I freely admit that despite the thought given to this weakness—the large wind resistance—and the steps taken to offset it, many nervous hours were spent when the weather acted up. Apprehension has now ended; a local newspaper reported the sad ending of a great many TV antennas as a result of "one of the worst sleet-and-wind storms in years." Our horn weathered it unscathed.

Success in keeping this antenna up is probably due to sturdy construction of the antenna, reinforcing the mast above the topmost guy support, and heavy guy wires at not too great an angle from the horizontal (see construction diagrams).

Antenna construction

Construction details on the horn antenna are given in Figs. 1, 2 and 3 and the method of mounting is shown in Fig. 4. Each side of the antenna (Fig. 1) is first covered by butting and lacing together pieces of 72 inch wide 2-inch chicken wire and then lacing it to the frame. Next, the 1-inch mesh is cut to size from a 36-inch width and then woven or laced to the frame and apex (feed-point) gusset.

The sides of the horn are 1 inch apart at the apex. This distance is maintained by a hardwood spacer bolted to the apex gussets as shown in Fig. 2. The 60° angle between the sides is maintained by two hardwood cross-arms cut as in Fig. 4.

The mast is 42 feet high and made of three tubes: the bottom section is a 25-foot length of slightly oversize 1½-inch pipe into which is telescoped a 20-foot length of 1¼-inch pipe for a distance of 3 feet. The third tube, a 12-foot length of 1-inch pipe, is telescoped almost completely into the top of the 1¼-inch pipe, to reinforce the 1¼-inch pipe at and above the top guy support. This third tube paid dividends. A survey of the damage caused by the recent storm revealed that many steel masts snapped off like matchsticks just above the topmost guy support. Most of the other damage involved failure of one of the top guy wires, permitting the wind to bend and twist the mast, steel or aluminum alloy like licorice. My mast was 61ST aluminum alloy.

The mast was supported at the 12-, 25- and 34-foot levels. The two top supports are each guyed with three wires—galvanized clothes line was used, stranded double for each of the top guys. I became very fussy about anchoring the guy wires after a tensile test revealed that the usual casual type of twisting would slip loose easily. The two guy-wire rings are ¼ inch thick, and the edges of the holes for the wires are rounded and smoothed to prevent the wires from being cut through.

Raising the mast is difficult, somewhat like fastening a brick to the business end of a buggy whip and standing it straight up with the brick topmost. Four or five assistants, plenty of extra length on the guy wires, lots of patience and an absence of wind simplify the operation.

Some comments on the material specifications may be appropriate. Square tubing is used because it makes it much easier to "square up" the structure. Fairly thin-walled tubing is not only satisfactory but desirable for lightness. As a substitute, 24ST alloy may be used. Alloy angles of 14ST or 24ST may be used, and any hard-rolled temper of 3S, 4S, 52S or 24ST should serve as a satisfactory substitute for the 61ST used for the gusset plates. Corrosion engineers will deplore the use of steel bolts in direct contact with the aluminum alloys. If aluminum-alloy, cadmium-plated or galvanized fasteners can be obtained, they should be used. If not, the use of steel should not shorten the life of the structure too much—it will probably last for years.

I did not specify the type of hardwood because I forget what it is. I told the lumber dealer what it was wanted for, and he supplied a straight-grained, knotfree variety.

Antenna performance

Comparisons must be qualitative rather than quantitative as I do not have a field-strength meter. Before moving, we lived in one of the higher-altitude districts of Kingston, Ontario. Using a 10-element Yagi cut for the high v.h.f. band, we pulled in channel 8 as well as or better than our immediate neighbors who had assorted types of antennas. We then moved to a low-lying area. From Syracuse, we were immediately behind a 50-foot hill covered with high trees and houses. Here, channel 8 was rather poorly received on the Yagi. When the horn antenna was erected there was a noticeable improvement.

During January and February reception here is at its worst. In these months we generally had a snowy, but intelligible, picture on channel 8, and an almost snowfree picture on channel 3. Besides Syracuse stations, channel 4 in Buffalo is frequently received, sometimes with excellent quality. Also, many programs have been enjoyed from Toronto and Rochester stations.

For those who have not seen Mr. Morgan's article, the feed-point impedance of the horn antenna is 375 to 400 ohms from the low v.h.f. band to the u.h.f. range. This is not too much of a mismatch for 300-ohm line—and possibly as good a match as many other broad-band types of antennas.

Some may point out that no means of rotating the antenna can be seen in the photo. There is a mechanical lever at the base of the mast. But there is no reason why a standard type of rotator cannot be used, provided that it is arranged so that the mast is given support above the rotator. END

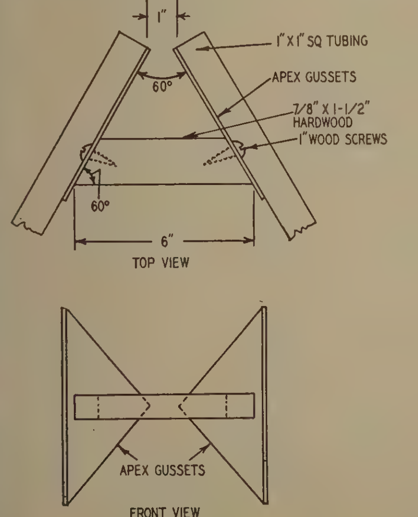


Fig. 2—The hardwood apex support.

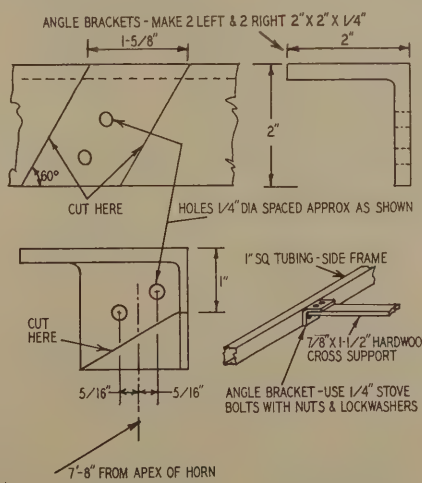


Fig. 3—Mounting the angle brackets.

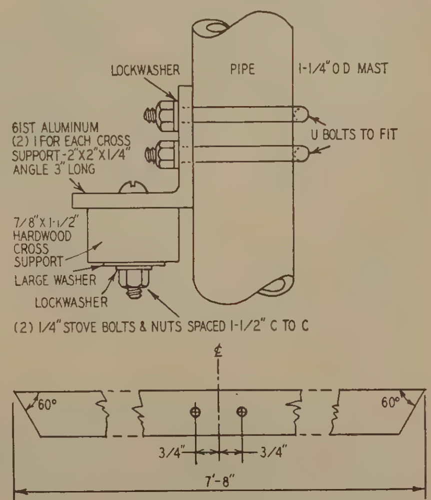
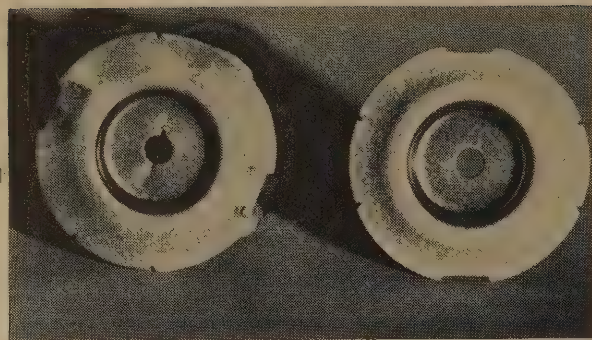


Fig. 4—The hardwood cross-supports.



Allen B. Du Mont Labs.

Anode-limiting aperture at left damaged by misalignment of electron beam. Disc at right is undamaged.

CONSIDERING the fact that the picture tube is the most expensive component of a TV receiver, surprisingly little attention is given to the selection and adjustment of the ion-trap magnet, a unit that can so materially affect the life of the tube. An improperly installed magnet robs the viewer of optimum performance and can severely damage the picture tube. The adjustment of the ion-trap magnet should not be haphazard—there is a technique.

The picture tube having an imperfect "vacuum" contains small amounts of gas molecules. Some of these "capture" free electrons and become negatively charged ions, taking their place in the tube's beam current along with other ions emitted from the surface of the cathode.

Because of their enormous weight as compared to that of the electron, the ions are only very slightly deflected by the vertical and horizontal magnetic fields. Thus, unless precautions are taken, the inertia of the gargantuan ions would send them crashing into the center of the picture tube, contaminating the screen phosphor and eventually producing a darkened center area called an ion spot. (See "Ion Burns" in the February, 1952, issue.) This deactivated area of the screen surface cannot be repaired. Picture tubes using low-voltage electrostatic focusing are especially prone to ion-spot damage.

Two methods are commonly used to prevent ion spots, both based on preventing ions from reaching the screen.

Bent-gun ion trap

In this system (Fig. 1) the cathode, control grid and accelerating anode are bent at an angle with respect to the rest of the gun so that the beam current (containing both ions and electrons), if allowed to flow in a straight line, would strike the side of the second anode and never reach the screen. By placing a magnetic field across the path of the beam current it is possible to direct the electrons toward the screen. However, the heavier ions are not affected by the magnetic field and are attracted to the second anode.

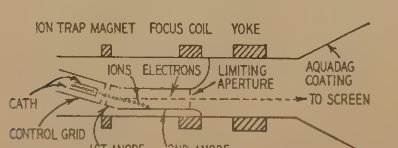


Fig. 1—Bent- or tilted-gun ion trap.

The bend in the gun structure is called the ion trap, and the external magnet that separates the electrons from the ions is called the ion-trap magnet or beam bender. Most TV receivers use a single permanent magnet. A few use a coil or electromagnetic type, supplied from a d.c. source in the set.

Slashed-field ion trap

A second type of ion trap (Fig. 2) uses an electrostatic field to deflect the beam current from the axis of the picture tube. The first and second anodes have a diagonal gap between them, with the first anode at a low voltage (approximately B plus) and the second at a high voltage. This produces a warped electrostatic field between the anodes. This field deflects beam current toward the second anode. (Ions are easily deflected by electrostatic fields. Thus, C-R tubes using electrostatic deflection need no ion-trap magnets. The ions are not concentrated, but swept over the face of the tube.)

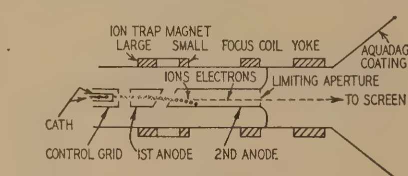


Fig. 2—Slashed-gun type of ion trap.

In this gun structure a double ion-trap magnet is used to set up the magnetic field in the path of the beam current. This field deflects the electrons toward the screen, leaving the undeflected ions trapped on the inner surface of the second anode.

The diagonal-cut (slashed) gun has a pair of internal pole pieces, called flags, attached to the gun structure. They direct and concentrate the magnet field and are an important guide in adjusting the ion-trap magnet.

Ion-trap magnet

The beam bender supplies a steady magnetic field with lines of force at right angles to the beam axis. When properly positioned, the magnet deflects the electron stream through the center of the limiting aperture at the front end of the second anode. Most picture tubes, having second anode voltages of from 10 to 16 kv, require magnets having a field strength of from 30 to 50 gausses.

Ion-trap magnets are usually of the permanent-magnet type and almost always made of Alnico. When a double-magnet type is used, the stronger of the two should be toward the base of the picture tube. Most tube manuals indicate whether a single or double magnet should be used.

Adjusting the ion-trap magnet

For maximum picture-tube life the ion-trap magnet should be adjusted at the time of installation in the home, after any movement of the picture tube and after any adjustment of the focus coil. Before making any adjustments be sure the deflection yoke is centered on the neck of the picture tube and pressed firmly against the flare of the tube.

With the set in operation, turn the contrast control completely counterclockwise and the brightness control to a low level until after the initial adjustment of the ion-trap magnet. This should be made immediately after the receiver is turned on. Keeping the brightness low is very important—picture tubes have been completely ruined in less than 30 seconds because of an ion-trap magnet being misadjusted while the beam current was high.

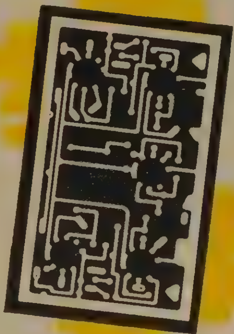
If the ion-trap magnet is incorrectly positioned, the electron stream strikes the edge of the hole in the accelerating anode instead of moving smoothly through it. The heat created by this contact can vaporize the disc metal, making proper focusing impossible and

NEW 1955

Heathkit Engineering Features

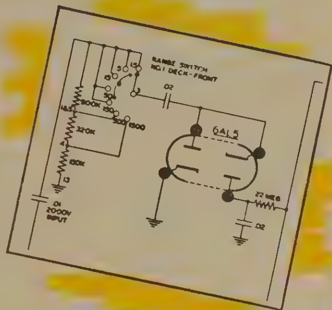
New PRINTED CIRCUITS

One of the many tremendous improvements in the new 1955 Heathkits is the use of an etched metal process printed circuit board. Printed circuits will be used in Heathkits whenever they will affect construction simplification, performance stabilization, and lend themselves to instrument design. Now for the *first* time a kit instrument company offers the advantages of modern printed circuit instrument construction technique. For the *first* time considerable attention has been given toward reducing kit assembly time. Also this is the *first* time that printed circuit boards have been hand soldered on a volume basis. Offered only by Heathkit, the pioneer and leader in kit instrument design.



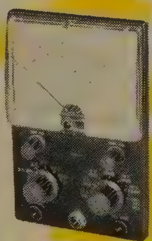
New PEAK-TO-PEAK VTVM CIRCUIT

New 6AL5 full wave rectifier in AC input circuit permits full scale peak-to-peak measurements. Seven ranges — upper limits 4000 volts peak-to-peak. Just the thing you TV servicemen have needed in making TV circuit voltage checks. Precision resistor voltage divider limits AC RMS level to 150 volts. Prevents overloading the rectifier—extends upper limit AC RMS ranges to 1500 volts—further protects meter and circuitry against AC flash-over or arcing. Another definite example of continuing Heathkit design leadership in the kit instrument field.



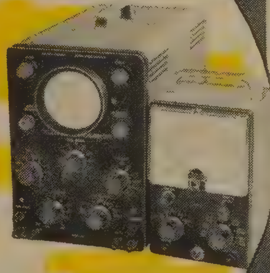
New HIGH READABILITY PANELS

New 1955 Heathkits feature complete panel redesign. Sharp white lettering applied to the beautiful charcoal gray panels, provide a new high in readability. Lettering is easy-to-read open style and panel calibrations are vividly clear against the pleasing soft gray background. New knobs of exclusive Heathkit design.



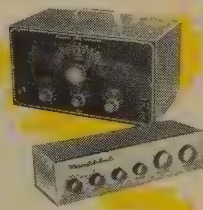
New 3" UTILITY SCOPE

The new 3" Scope is a "natural" for the well rounded line of Heathkit instruments. Small in size, 11¾" deep, 6½" wide, 9½" high, yet big in performance. Just think of the value. an Oscilloscope for $29.50. Brilliant intensity, sharp focusing, wide positioning range. An ideal portable Scope for the TV serviceman—a second shop scope—modulation monitor for you hams (deflection plate terminals in rear of cabinet). Performance to spare for all general scope applications. See specifications on following page.



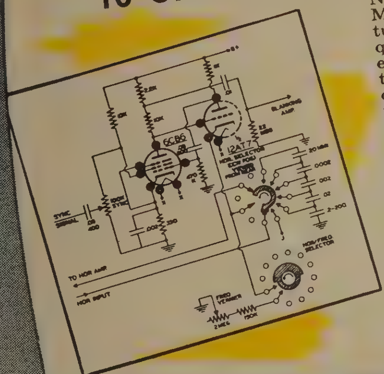
New STYLING *New* COLOR

New styling and coloring is responsible for tremendous improvement in Heathkit appearance. The new instrument panel color combination is high definition white lettering in a soft charcoal gray panel. Cabinet color is a lighter feather gray. The satin gold baked enamel cabinet for the WA-P2 Preamplifier is further indicative of the modern pacesetting trend in Heathkit styling.



New SCOPE SWEEP CIRCUIT 10 CYCLES — 500 KC

New 1955 Heathkit Model 0-10 Scope features a new wide frequency range sweep generator covering 10 cycles to 500,000 cycles. This coverage is available in five virtually decading sweep ranges and is five times greater than the sweep frequency range usually available. Excellent retrace time characteristics, actually less than 20% at 500 KC. Use of the free running Heath circuit provides a larger margin of stability and a new high in Heathkit Scope performance.



Continuing PROGRESS FUTURE LINE EXPANSION

The outstanding improvements featured in the 1955 Heathkit line are representative of the progress characterized by Heath Company operation. Long range planning will provide a continuing succession of new kit releases to further expand the Heathkit line which already represents the world's greatest selection of electronic kits. The innovations in the 1955 line, are representative of additional new models scheduled for release for the coming years.

SEE THE INSTRUMENTS ON THE FOLLOWING PAGES

HEATH COMPANY • • Benton Harbor 20, Mich.

releasing gas that is extremely harmful to the tube. The vaporized material is usually carried along and deposited on the screen of the tube, appearing as a dark spot. Thus, the lower the beam current during adjustment, the less the possibility of damage. In large-screen tubes the problem is more serious because of the higher voltages which hasten the damage.

Place the ion-trap magnet on the neck of the tube, directly over the slash or bend in the gun structure. If the flags can be seen, use them as a guide. Move the magnet forward and backward, at the same time rotating it slightly in both directions until maximum screen brightness is obtained.

The ion-trap magnet is basically a beam-centering device. However, it is not the only unit that affects beam centering. Thus, best centering is indicated by maximum brightness. There are often two positions of maximum brightness—use the one nearest the base of the picture tube. The second maximum is caused by the ion-trap magnet being too close to the focus coil or magnet. The interaction of the two fields causes a maximum brightness in the wrong position, one that can damage the electron gun. If in making the adjustment the magnet has to be moved more than ½ inch from the starting point, the magnet is probably weak and should be replaced.

Bring the screen brightness up to normal and again adjust the ion-trap magnet for maximum brightness. At this point adjust the focus control to obtain a clear line structure on the raster. Then make a final adjustment of the ion-trap magnet for maximum brightness, with the brightness control set to the maximum position with which good line focus can be maintained.

If corner shadows appear after the ion-trap magnet has been adjusted for maximum brightness, adjust the deflection yoke, focusing device or centering magnet to eliminate them. Tilting the focusing device sometimes aids in beam centering. *The ion-trap magnet should never be used to center the raster or eliminate corner shadow if, in so doing, the screen brightness is reduced.*

With the magnet at its optimum position, make it tight. If the magnet is coded with a dot or arrow, the coding should be toward the picture-tube face. Should a magnetic shunt be clipped on the magnet, do not disturb it.

Some manufacturers consider the ion-trap adjustment of such importance that they coat the edge of the accelerating anode opening with a luminescent material. This gives a warning fluorescent glow, usually blue or green, when the electron beam is off center. The ion-trap magnet should be set for minimum glow in the neck of this type tube.

Keep in mind that the ion-trap adjustment and the focusing and center-

ing controls are usually interdependent. Any adjustment of one will usually necessitate an adjustment of the others. However, make the final adjustment that of the ion-trap magnet, and do it carefully—picture tubes are expensive.

Defective crystal

The picture became very faint in an RCA model 17T150. The raster was bright, and what could be seen of the picture was clear. After checking the video amplifier I discovered the video detector crystal, marked CR101, was defective. I replaced it with a 1N64 which I have used in similar circuits. The picture returned with normal brightness but seemed to lack detail. There even seemed to be slight smearing.

I have replaced all tubes in the video amplifier and have aligned — to the best of my ability — the i.f. amplifier. Other components checked in the video amplifier match with my schematic. I would appreciate any suggestions you may have.—H. M., Groton, Conn.

RCA uses various types and makes of crystals for CR101, the most common being the 1N60, 1N64 and CK706. Their characteristics vary slightly and the crystals are often not directly interchangeable. On the production line RCA compensates for these variations by changing the value of the resistor across the primary of the fifth i.f. transformer which is normally 10,000 ohms. By varying this resistance from 5,600 to 10,000 ohms a value that gives optimum video response will be reached. In many cases the most practical approach is to replace the fifth i.f. video transformer containing the diode, shunt resistor and other video detector components. This assures a good match. If the smear cannot be eliminated, check the value of the load resistor in the plate circuit of the video amplifier.

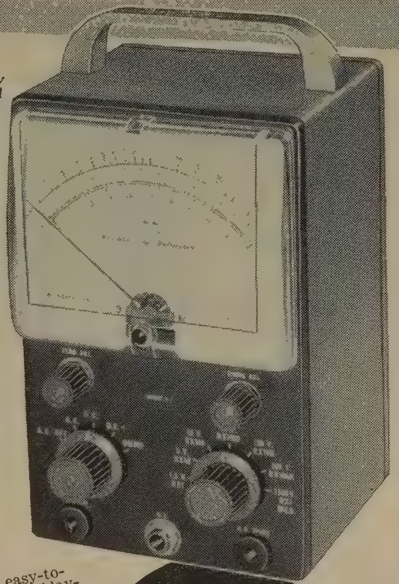
Oscillation in output stage

I have a very peculiar condition in a G-E model 12K1. When the set is turned on, it operates perfectly until I change channels. At this time horizontal sync is lost and I cannot obtain stable sync despite turning the horizontal hold on the front panel and in the rear through their full range. However, when the set is turned off for a few minutes and then turned on, it will play perfectly again until I change channels. I have changed every tube in the horizontal sweep circuit without success. I don't see why a change in signal should affect a circuit that is supposed to operate continuously.—A. H., Fort Wayne, Ind.

The symptoms you describe could very well be caused by a defect in the horizontal a.f.c. circuit. However, this effect is fairly common in receivers using a horizontal output circuit where a voltage is fed back to the grid of the horizontal output tube from the secondary of the flyback transformer.

NEW *Heathkit* VACUUM TUBE VOLTMETER KIT

PRINTED CIRCUIT DESIGN



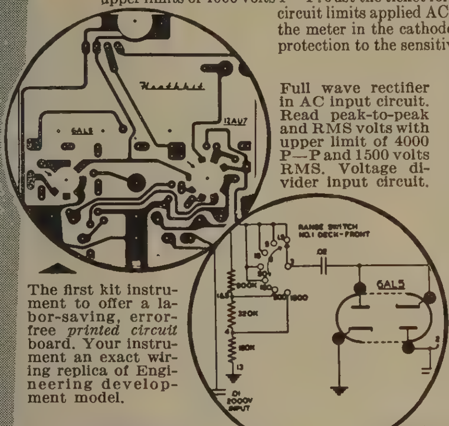
New charcoal gray baked enamel panel with high readability, white lettering. New soft feather gray cabinet, subdued pilot light indicator.

New printed circuit board for faster, easier construction—exact duplication of Lab development model.

Another outstanding example of continuing Heath Company pioneering and leadership in the kit instrument field. A new **printed circuit** VTVM. New peak-to-peak circuit—new styling and new panel design. A prewired, prefabricated printed circuit board eliminates chassis wiring, cuts assembly time in half, assures duplication of Engineering pilot model specifications, and virtually eliminates possibility of construction error.

CIRCUIT:

A 6AL5 tube operated as a full wave AC input rectifier permits seven peak-to-peak voltage ranges with upper limits of 4000 volts P—P. Just the ticket for you TV servicemen. Voltage divider in the 6AL5 input circuit limits applied AC input to a safe level. This circuitry and the isolation of the meter in the cathode of the 12AU7 bridge circuit affords a high degree of protection to the sensitive 200 microampere meter.



Full wave rectifier in AC input circuit. Read peak-to-peak and RMS volts with upper limit of 4000 P—P and 1500 volts RMS. Voltage divider input circuit.

The first kit instrument to offer a labor-saving, error-free *printed circuit* board. Your instrument an exact wiring replica of Engineering development model.

RANGES:

Seven voltage ranges. 1.5, 5, 15, 50, 150, 500 and 1,500 volts DC and AC RMS. Peak-to-peak ranges 4, 14, 40, 140, 400, 1400, 4000. Ohmmeter ranges X1, X10, X100, X1000, X10K, X100K, X1 meg. Additional features are a db scale, a center scale zero position, and a polarity reversal switch.

New easy-to-read open panel layout. Off-on switch now incorporated in the selector switch.

MODEL V-7

$24.50

Shpg. Wt. 7 lbs.

IMPORTANT FEATURES:

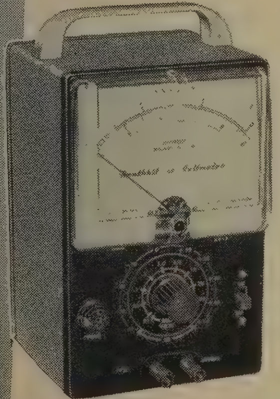
High impedance 11 megohm input—transformer operated—1% precision resistors, 6AL5 and 12AU7 tube—selenium power rectifier— individual AC and DC calibrations—smoother improved zero adjust control action—new panel styling and color—new placement of pilot light—new positive contact battery mounting—new knobs—test leads included.

The new V-7 also sets the pace as a kit instrument style leader. Smart, good-looking charcoal gray panel and soft feather gray cabinet. High readability panel with sharply contrasting white calibrations. The pleasing, eye catching, modern styling is in harmonious balance with the outstanding circuit design improvements. Easily the best buy in kit instruments.

New peak-to-peak meter scale—new color harmony—new knobs.

Heathkit AC VACUUM TUBE VOLTMETER KIT

MODEL AV-2

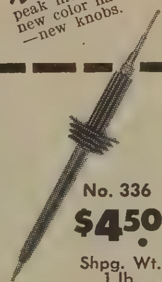


$29.50 Shpg. Wt. 5 lbs.

Extreme sensitivity has been emphasized in the design of the Heathkit AC VTVM. Ten full scale RMS ranges are .01, .03, .1, .3, 1, 3, 10, 30, 100, and 300 volts. Frequency response is substantially flat from 10 cycles per second to 50 KC with input impedance of 1 megohm at 1 KC. Will accurately measure as low as 1 millivolt at high impedance. Total db range is —52 db to +52 db. An excellent kit for measuring the output of phono cartridges and the gain of amplifier stages. Use it also to check power supply ripple, as a sensitive null detector, and for compiling frequency response data. Features one knob operation, 200 microampere Simpson meter and precision resistors.

Heathkit 30,000 VOLTS DC PROBE KIT

Measure up to 30,000 volts DC with the Heathkit VTVM and the 336 high voltage Probe. Precision resistor provides multiplication factor of 100. Can be used with any 11 megohm input VTVM. Housed in a Polystyrene two color sleek plastic probe body for safety of operation.



No. 336

$4.50

Shpg. Wt. 1 lb.

Heathkit PEAK-TO-PEAK PROBE KIT

No. 338-C

$5.50

Shpg. Wt. 2 lbs.

Peak-to-peak values not exceeding 80 volts at a DC level of not more than 600 volts, can now be read directly by using 338-C Probe with previous model Heathkit VTVM's or any VTVM with 11 megohm input resistance. Probe construction features a modern printed circuit board for easy assembly. Frequency range 5 KC to 5 MC.

Heathkit RF PROBE KIT

The Heathkit RF Probe will permit the measurement of RF voltages up to 250 MC with an accuracy of ±10%. The limits are 30 volts AC and a DC level of 500 volts. Designed for any 11 megohm input VTVM. Modern styling, Polystyrene aluminum housing, Polystyrene insulation, and printed circuit board for easy assembly.

No. 309-C

$3.50 Shpg. Wt. 1 lb.

Heathkit AUDIO WATTMETER KIT

Read audio power output directly without using external load resistors with the new Heathkit Audio Wattmeter. Built-in non-inductive load resistors provide impedances of 4, 8, 16, and 600 ohms. Flat response from 10 CPS to 250 KC. Full scale power ranges are 0–5 MW, 0–50 MW, 0–500 MW, 0–5 W and 0–50 W. Model AW-1 will operate continuously at 25 watts and has a duty cycle of 3 minutes at 50 watts. Total db range in five positions is —50 db to +48 db, using the standard 1 milliwatt 600 ohms.

MODEL AW-1

$29.50

Shpg. Wt. 6 lbs.

HEATH company

A SUBSIDIARY OF DAYSTROM, INC.

BENTON HARBOR 20, MICHIGAN

TELEVISION

The trouble is probably oscillation in the output stage due to excessive feedback. You can check this by removing the horizontal oscillator tube once the trouble starts. If you continue to have sweep and high voltage, this unwanted oscillation is taking place. When the 6-$\mu\mu$f feedback capacitor (C330 on G-E diagrams) breaks down, it changes in capacitance to as much as 300 $\mu\mu$f. This gives sufficient feedback for oscillation. Thus when the control voltage from the a.f.c. circuit is altered during channel changes, self-oscillation takes over. Replace this unit with a 1,500-volt mica capacitator.

Picture and sound loss

I am servicing a Meck receiver which apparently has a bad tuner. I get no picture and no sound, but a raster is present. I would like some information on replacing the existing tuner with the new Standard cascode tuner. There is no model number on this receiver, but the circuit checks with the Meck model XQA. H. S., Cleveland, Ohio.

You mentioned that the tuner is bad, but did not explain how you arrived at this conclusion. If this receiver is similar to the XQA model, it is an intercarrier receiver and the sound take-off is at the video amplifier. In such an instance the lack of picture and sound (with a raster present) could be caused by a defective tube or circuit in the tuner, the video i.f. amplifiers, the video detector or the video amplifier. Thus, your idea of replacing the tuner to correct this trouble may not be the solution. If a defective tube or part exists in the video i.f. stages or the detector or video amplifier, the new tuner would be of no help.

The Standard cascode tuner is supplied with complete schematic and installation instructions. You can find additional information on cascode tuners in previous issues of RADIO-ELECTRONICS as follows: January, 1953, page 49; September, 1953, page 58; January, 1954, page 43.

Poor focus

I recently replaced a 19AP4A picture tube in a Sentinel model 425 receiver. This seriously disturbed the focusing, especially around the center of the picture. Adjusting the focus magnet was of some help, but still left the picture bady focused. What could have caused the trouble?—C. D., Scranton, Pa.

This very common trouble in the case of replaced 19AP4A metal tubes is caused by changes in electrical design of the tube. A remedy which in most instances is highly effective is to lower the d.c. plate voltage to the horizontal output tube. This can be done by inserting a 1,000-ohm, 5- to 10-watt resistor between the horizontal output transformer and the boost voltage source (linearity coil). Adjust the horizontal drive to −25 volts. If width is lacking, shunt a .05-μf capacitor across the width coil. END

tv dx

April–June

A RISING sunspot curve, the first January aurora of major proportions in several years, the most active winter skip season in the history of TV dx—these are the signs that make for optimism among the TV dx enthusiasts. The next three months, April through June, will tell the story, for in this period comes the rush of sporadic-E dx that everyone waits for through the early spring.

Dx-ers in the Gulf States may get their first licks in sometime in the latter part of March or early April. More northerly observers will more than likely have to wait until May before catching many good ones, if 1955 follows previous years. Indications are, however, that this spring's activity will get under way earlier than any since chasing TV dx became a major hobby.

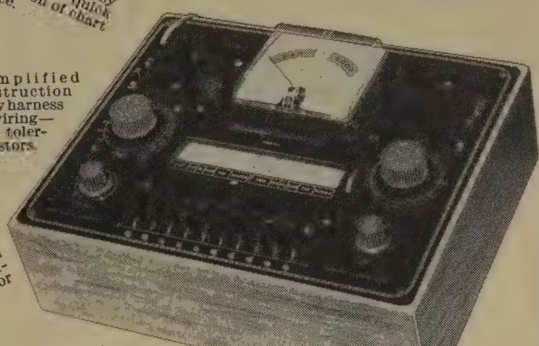
Observer Bedford Brown, Jr., Hot Springs, Ark., logged 37 stations during January, 23 of them sporadic-E dx. Mexico and Texas stations were logged between 11:20 am and 8:05 pm, Jan. 1, channels 2, 4 and 5. Jan. 3, 4:30 to 6:10 pm, Bedford caught WCBS, N. Y.; XEW, Mexico City, and CBFT, Montreal, all channel 2. Jan. 4, 4:30 to 9:00 pm: WUSN-2, Charleston, S. C.; WSB-2, Atlanta, Ga. (523 miles, short skip for winter); WFMY-2, Greensboro, N. C.; WBTV-3, Charlotte, N. C.; WMBR-4, Jacksonville, Fla.; WCSC-5, Charleston, S. C., and WMFD-6, Wilmington, N. C. Jan. 5: several unidentified, northeast. Jan. 18, 7 am: WMBR. Jan. 25, 9–9:30 pm; CMQ–TV, Havana, Cuba. Jan. 28: unidentified, northeast. Jan. 31, 4:30 to 7 pm: XEW-2, XHTV-4 and XHGG-5, all Mexico City; KRGV-5, Weslaco, and KGBT, Harlingen, Tex.; KUTV-2, Salt Lake City, Utah; KFEL-2 and KOA-4, Denver, Colo.; KTVT-4 and KSL-5, Salt Lake City. Quite a list, for January!

Brown also reports burst reception almost every day, though he has identified only five stations in 3½ years by this medium—presumably reflections from meteor trails. His catches via bursts include WBEN-4, Buffalo, N. Y.; WBZ-4, Boston, Mass.; WRGB-4 (now 6), Schenectady, N. Y.; WEWS-5, Cleveland, Ohio, and WSPD-13, Toledo, Ohio.

Tommy Blalock, Tallahassee, Fla., reports that his January skip reception was in longer, with steadier signals, than he has ever experienced before in the winter months. His best days were Jan. 23, 27, 28 and 31, with reception from Denver, Mexico City, Midland and El Paso, Tex., channels 2–5.

(*Continued on page 77*)

Heathkit TUBE CHECKER KIT



The Heathkit TC-2 Tube Checker was primarily designed for the convenience of radio and TV servicemen and will check the operating quality of tubes commonly encountered in this type of work. Test set-up procedure is simplified, rapid, and flexible. Panel sockets accommodate 4, 5, 6, and 7 pin tubes, octal and loctal, 7 and 9 pin miniatures, 5 pin Hytron, and a blank socket for new tubes. Built-in neon short indicator, individual 3-position lever switch for each tube element, spring return test switch, 14 filament voltage ranges, and line-set control to compensate for supply voltage variations, all represent features of the TC-2.

MODEL TC-2
$29.50
Shpg. Wt. 12 lbs.

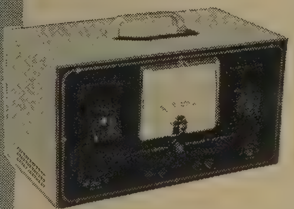
Results of tube tests are read directly from the large 4½" Simpson 3-color meter. Checks emission, shorted elements, open elements, and continuity. Wiring procedure has been simplified through the use of multi-wired color coded cable providing a harness type installation between tube sockets and lever switches. This procedure insures standard assembly and imparts a "factory built" appearance to the instrument. New Construction Manual furnishes detailed information regarding tube set-up procedure for testing of new or unlisted tube types. No delay necessary for release of factory data.

Heathkit PORTABLE TUBE CHECKER KIT

The portable model is supplied with a strikingly attractive two-tone cabinet finished in rich maroon proxylin impregnated fabric covering with a contrasting gray on the inside of the detachable cover.

MODEL TC-2P
$34.50
Shpg. Wt. 15 lbs.

Heathkit REGULATED POWER SUPPLY KIT



MODEL PS-2
$33.50
Shpg. Wt 15 lbs.

Here is a source of regulated D.C. voltage for circuit development work. Power supply voltage and current drain to the circuit under test are constantly monitored by the 4½" panel mounted meter. Separate 6.3 volt at 4 ampere A.C. filament source available. The regulated and variable output voltage will be constant over wide load variations, and hum ripple will not exceed .012% at 250 volts under a 50 MA load. Completely isolated circuit, standby switch, and other desirable features, make the Model PS-2 extremely useful in a wide variety of applications.

Heathkit TV PICTURE TUBE TEST ADAPTER

The Heathkit TV Picture Tube Test Adapter used with the Heathkit Tube Checker Kit, will quickly check picture tubes for emission, shorts, etc. and determine tube quality. Consists of standard 12-pin TV tube socket, four feet of cable, octal socket connector, and data sheet.

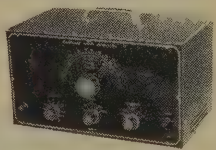
No. 355
$4.50 Shpg. Wt. 1 lb.

Heathkit DECADE RESISTANCE KIT

MODEL DR-1
$19.50
Shpg. Wt. 4 lbs.

Twenty 1% resistors are decaded in 1 ohm steps to provide any value between 1 ohm and 99,999 ohms. Sturdy ceramic switches with silver plated contacts insure reliable service. Use the Decade Resistance in bridge circuits, meter multipliers, calibrations, or any application requiring a wide range of precision resistance values.

Heathkit AUDIO GENERATOR KIT



Here is an Audio Generator with features generally found only in the most expensive instruments. Sine wave coverage from 20 cycles to 1 Megacycle—response flat ±1 db from 20 cycles to 400 Kc—continuously variable and step attenuated output. Because the output voltage is relatively constant over wide frequency ranges, the AG-8 is ideal for running frequency response curves in audio circuits. Once set by means of the attenuator, this voltage may be relied upon for accuracy within ± 1 db. Instrument features low impedance 600 ohm output circuit and distortion less than .4 of 1% from 100 CPS through audible range.

MODEL AG-8
$29.50
Shpg. Wt. 11 lbs.

Heathkit DECADE CONDENSER KIT

The Heathkit Decade Condenser provides a ready source of capacity values from 100 mmf to .111 mfd inclusive in capacity steps of 100 mmf. Silver plated contacts on husky ceramic switches, assure positive contact for each switch position. Precision silver mica condensers ±1% accuracy for close tolerance accurate work.

MODEL DC-1
$16.50
Shpg. Wt. 3 lbs.

HEATH company
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BENTON HARBOR 20, MICHIGAN

NEW *Heathkit* HIGH FIDELITY PREAMPLIFIER KIT

Equalization for LP, RIAA, AES, and early 78.

Separate bass and treble tone controls—special hum control.

Cathode follower low impedance output circuit.

Beautiful, modern appearance, blends with any interior color scheme.

Five switch selected inputs with individual level controls.

Here is the exciting new Heathkit Preamplifier with all of the features you Audiophiles have asked for and at a down-to-earth price level. Beautiful satin gold baked enamel finish, striking control knobs and arrangement, attractive custom appearance and entirely functional design.

DESIGN:

Uses three twin triode tubes in a shock mounted chassis, 2-12AX7 and 1-12AU7. Features tube shielding, plastic sealed color coded capacitors, smooth acting controls, good filtering, excellent decoupling, low hum and noise level, and all aluminum cabinet. Special balancing control for absolute minimum hum level. Cathode follower, low impedance output circuit for complete installation flexibility.

SPECIFICATIONS:

Provides five switch selected inputs, 3 high level, and two low level, each with individual level controls—4 position LP, RIAA, AES, and early 78 equalization switch—4 position roll-off switch, 8, 12, 16 with one flat position. Separate tone controls, bass 18 db boost and 12 db cut at 50 CPS, treble 15 db boost, and 20 db cut at 15,000 CPS. Power requirements from Heathkit Williamson Type Amplifier power supply 6.3 volts AC at 1 ampere, and 300 volts DC at 10 MA. Over-all dimensions 12$\frac{9}{16}$" wide x 5$\frac{7}{8}$" deep x 3$\frac{5}{8}$" high.

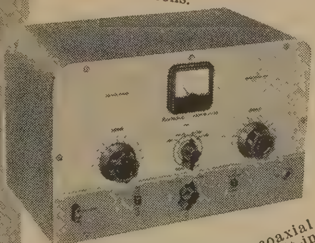
APPLICATION:

The new Heathkit WA-P2 Preamplifier has been designed to operate with any of the Heathkit Williamson Type Amplifiers and is directly interchangeable with the previous Model WA-P1 Preamplifier unit. Order your kit today and enjoy completely smooth control over the operation of your Hi-Fi system. Obtain the exact tonal balance of bass and treble with the precise degree of equalization you want. Note that the design of the WA-P2 accommodates the newly established RIAA curve.

MODEL WA-P2
$19.75
Shpg. Wt. 7 lbs.

HAM EQUIPMENT

Heathkit AMATEUR TRANSMITTER KIT



Single knob band switching—prewound coils.

Crystal or VFO excitation—metered operation.

52 Ohm coaxial output—built-in power supply.

MODEL AT-1
$29.50
Shpg. Wt. 16 lbs.

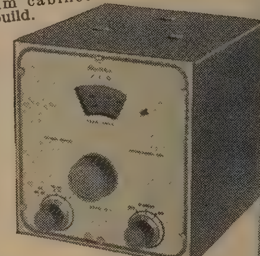
The Heathkit AT-1 Transmitter has established a high reputation and has been enthusiastically accepted by hundreds of experienced operators as well as beginners. Power input up to 35 watts for the novice and suitable as a standby exciter for your higher powered rig later on.

Model AT-1 can be crystal or VFO excited and operates on 80, 40, 20, 15, 11 and 10 meters. The prewound coils with the oscillator and amplifier are switched simultaneously by the rugged band switch. Meter switch allows a reading of the final grid and plate current on the panel mounted meter. Modulator input and VFO power sockets are provided as well as a key jack for CW operation. Other features include a crystal socket, standby switch, key click filter, AC line filter, good shielding and a 52 ohm coaxial output. The 425 volt, 100 milliampere power supply and 5U4 rectifier are more than adequate for the 6AG7 oscillator multiplier and 6L6 amplifier doubler.

Brand NEW HEATHKIT VFO KIT

Smooth acting illuminated and precalibrated dial.

Copper plated chassis—aluminum cabinet—easy to build.



Seven band coverage 160 through 10 meters at 10 volt RF output.

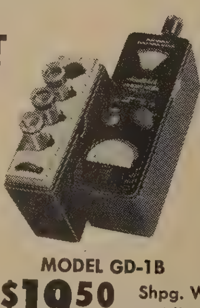
6AU6 electron coupled Clapp oscillator and OA2 voltage regulator.

MODEL VF-1
$19.50
Shpg. Wt. 7 lbs.

The new Heathkit VFO is the perfect companion to the Heathkit Model AT-1 Transmitter and it has sufficient output to drive any multi-stage transmitter of modern design. Good mechanical and electrical design insures operating stability. Coils are wound on stable, heavy duty, ceramic forms using Litz or double cellulose wire coated with Polystyrene cement and baked for humidity protection. Variable capacitor of differential type construction, especially designed for maximum bandspread. Kit is furnished with a carefully precalibrated scale which provides well over two feet of scale length. Smooth acting vernier reduction drive and illuminated dial provides easy tuning and zero beating.

Power requirements 6.3 volts AC at .45 amperes, and 250 volts DC at 15 mils. Just plug it into the power receptacle provided on the rear of the AT-1 Transmitter. Seven band coverage 160 through 10 meters with 10 volt average RF output. Uses 6AU6 electron coupled Clapp oscillator and OA2 voltage regulator.

Heathkit GRID DIP METER KIT



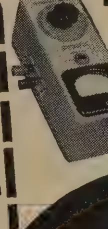
The invaluable instrument for Hams, servicemen and experimenters. Useful in TV service work, for alignment of traps, filters, IF stages, peaking compensation networks, etc. Locates spurious oscillation, provides a relative indication of power in transmitter stages. Use it for neutralization, locating parasitics, correcting TVI, measuring CL and Q of components, and determining RF circuit resonant frequencies. The variable meter sensitivity control, headphone jack, 500 microampere Simpson meter, continuous frequency coverage from 2 MC to 250 MC. Prewound coil kit and rack included.

LOW FREQUENCY COILS:

Low frequency range extended to 355 KC by the use of two additional coils. Complete with dial correlation curves. Set 341-A for GD-1B and set 341 for GD-1A. Shipg. wt. 1 lb. Price **$3.00**

MODEL GD-1B
$19.50
Shpg. Wt. 4 lbs.

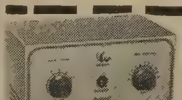
Heathkit ANTENNA IMPEDANCE METER KIT



MODEL AM-1
$14.50
Shpg. Wt. 2 lbs.

Determine antenna resonance and resistance, transmission line surge impedance, and receiver input impedance. Works with one-half and one-quarter wave lines, half wave and folded dipoles, harmonic mobile and beam antennas. Resistance type SWR bridge —100 microampere meter—frequency range 0-150 MC—impedance range 0-600 ohms.

Heathkit ANTENNA COUPLER KIT



MODEL AC-1
$14.50
Shpg. Wt. 4 lbs.

For the Heathkit AT-1 Transmitter or any comparable Amateur Transmitter. Will handle power up to 75 watts at its 52 ohm coaxial input. Matches a wide range of antenna impedances with its L type tuning network and neon indicator. A tapped inductance provides coarse adjustment and a transmitting type variable condenser sets it "right on the nose." Will operate on the 10 through 80 meter bands.

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BENTON HARBOR 20, MICHIGAN

Tommy also saw bursts on numerous occasions, too short and erratic for identification.

Raymond Sloss, Baton Rouge, La., reports a jumble of stations, 6:30 to 8 pm, Jan. 4, with WBBM-2, Chicago; WBAY-2, Green Bay, and WTMJ-4, Milwaukee, Wis., and KOA-4, identified. Raymond also had good Western reception Jan. 31, 5:30 to 7 pm, logging KOB-4, Albuquerque, N. M.; KPHO-5, Phoenix, Ariz.; KMID-2, Midland, and KROD-4, El Paso, Tex.

On Feb. 1 Art Collins, Buffalo, N. Y., caught WOW-6 and KMTV-3, Omaha, Neb.; WOI-5, Ames, Iowa; KFBC-5, Cheyenne, Wyo.; WKY-4, Oklahoma City, and KCKT-2, Great Bend, Kans., mostly very strong and steady, for three hours, beginning at 4:30 pm.

We report these individual loggings in detail to show the considerable extent of the midwinter dx. There was plenty more in the latter half of December. Viewers who think that early summer is the only time that dx is worth bothering with are missing more than they know!

Over 50 TV dx club

In the summary of TV dx for 1954, printed in the February issue, we started listing the standings of observers who have reported totals to us. Membership in the "Over 50 Club" is bound to grow. If you want to join, send us your total of stations received (positively identified by yourself; verifications not required). If you have a u.h.f. receiver, record the number of u.h.f. calls. Give the call of the most distant station you've logged; and if you photograph identifications, let's have your photo record, too. Here are changes and additions since the 1954 summary was prepared.

NAME	LOCATION	TOTAL	BEST DX
Bedford Brown, Jr.	Hot Springs, Ark.	176	
Louis Matullo	Washington, Pa.	149	
F. E. DeGroat	Salamanca, N. Y.	94	
Robert Weems, Jr.	State College, Miss.	110	
Tommy Larkins	Clarkville, Tenn.	70	
New Members			
Skipper Easter	Vinton, Iowa	95	
Sam Brooks	Boston, Ga.	90	
Edward Fournier, Jr.	Bradford, R. I.	64	1,500
Tommy Mayo	Boston, Ga.	54	
Larry Whiting	Ilderton, Ont.	53	1,500

In the above summary, 19 of the 149 stations logged by Louis Matullo were in the u.h.f. range. In addition, 113 of the stations were photographed. This is really a comprehensive report and worthy of particular commendation. Let's have more of these. END

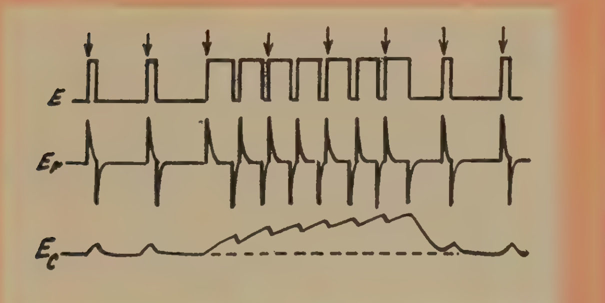
Implosion, It Was
by Jeanne DeGood

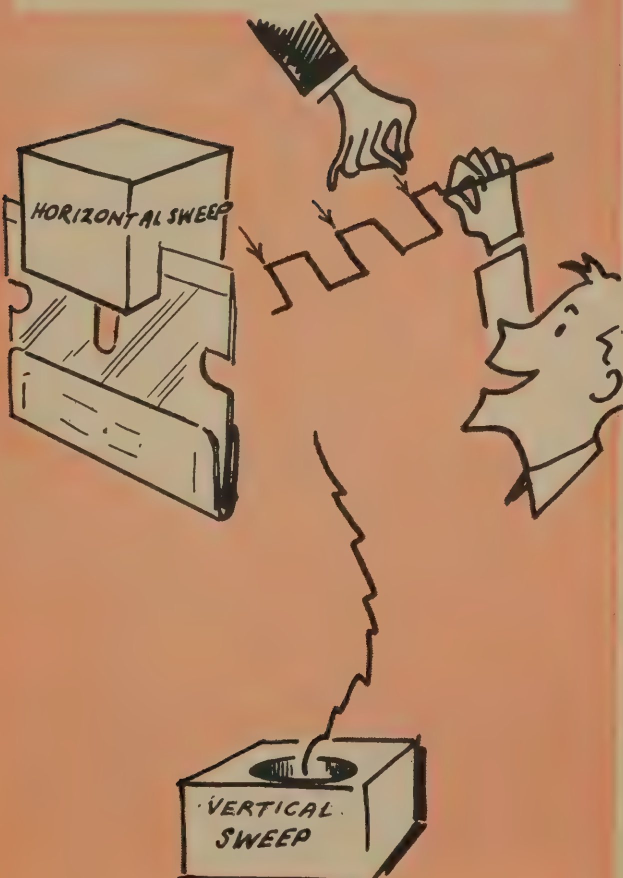
"A picture tube will not explode,"
Boastful, Careless Charlie crowed,
And then I waved the guy goodbye
As he went by me—flying high.

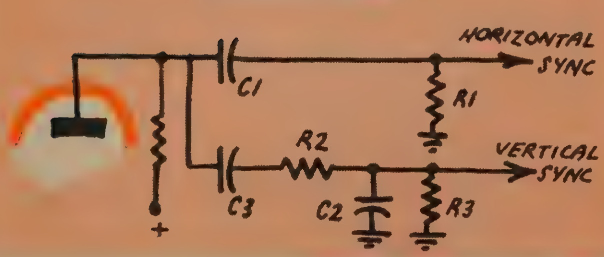
TELEVISION . . . it's a cinch!

By E. AISBERG

Fifteenth conversation, third part: Differentiation and integration in action, effect of the time constant







KEN—When worse comparisons are pulled, you'll pull 'em! Only remember what we've just said—that the same circuit can be an integrator or differentiator, depending on whether the voltage is taken across the resistor or the capacitor. In a differentiator circuit R and C should be fairly small, so their product—their time constant, in other words—won't be greater than about one-fifth the duration T of the pulse. But R and C should both be much larger in an integrator circuit, so the time constant is several times longer than T.

WILL—So, even if you do use just a resistor and a capacitor for either a differentiator or an integrator circuit, the circuits really are different, since you choose different values. But I still don't see just what you do with them.

KEN—You should by this time. Draw the form of a sync signal as it comes out of the separator.

WILL—Here's a nice row. First we have two horizontal pulses, then the longer vertical ones, then line pulses again.

KEN—Now let's mark the points where the horizontal sweep oscillator is triggered. Remember how we found that the horizontal sync had to be maintained throughout the vertical sync pulse? Now do you think you could show how those signals would look if they were differentiated?

WILL—According to what you've just said, the time constant should be very short—less than one-fifth the duration of the pulses—which pulses?

KEN—The shortest ones—the horizontal pulses.

WILL—Well, we get very sharp, narrow differentiated pulses, positive or negative according to whether they are at the beginning or end of the pulse.

KEN—Those razor-blade signals are perfect for synchronizing the lines. Now try to draw the signals coming out of an integrator.

WILL—H'm, this circuit must have a time constant quite a bit longer than the duration of the pulse. But we won't get much of an output pulse from it! The capacitor just starts to charge when the voltage is removed and it starts to discharge again.

KEN—All the better, Will. If you can't find the horizontal pulses in the output of the integrator, you're doing well. Notice how the circuit reacts when the vertical pulses come along?

WILL—They last a little longer, so the capacitor has a chance to charge up a little more. But it discharges a little between the first and second pulses. Then during the second pulse it charges up some more. Then there is another little discharge, another bigger charge, and so on. Each charge ends up with a little more voltage on the capacitor, and the whole picture looks something like a set of steps.

KEN—With this difference: as the voltage rises, the steps become shorter.

WILL—That exponential law again! But everything has to come to an end. And when the train of vertical pulses stops, the capacitor discharges, giving you another perfect exponential curve.

KEN—Not quite perfect, Will, because it gets little jolts from the horizontal pulses following . . .

WILL . . . so because of our integrator circuit, the whole group of vertical pulses begins to look like a long sawtooth where the line pulses practically disappear, leaving only insignificant jags along its top. Now what are we going to do with this integrated voltage?

KEN—You apply it to the vertical time base and, if you have luck, these pulses will synchronize it perfectly. If you want to refine the circuit further, you can use a biased diode to smooth off the rough edges and pass only the voltage peaks. But that's not necessary. You can have a very simple selector circuit in which the voltage across the

separator load resistor is applied to a differentiator circuit C1-R1 which goes to the horizontal circuits and also to an integrator circuit R2-C2 which is connected to the vertical oscillator.

WILL—And how about C3 and R3?

KEN—C3 is a coupling capacitor that keeps B plus out of the time-base circuits. And R3 is a grid resistor.

WILL—But won't C3 and R3 constitute themselves a sort of differentiator that will disturb the integrator action?

KEN—Don't worry—you can choose their values so they have an insignificant differentiating effect.

Exponential ladder

WILL—Why did you say "if you have luck" when you spoke of sychronizing the vertical sweep circuit?

KEN—Oh, I have no love for those integrator circuits. The vertical signal isn't neat—it has no shape! Give me differentiators, where the signal appears at full amplitude the precise instant you need it!

WILL—Yes, but you can't use a differentiator to build up your vertical pulse!

KEN—Why not? Suppose I just use a capacitor and resistor large enough to give me a time constant a lot longer than that of the horizontal pulses?

WILL—I don't see how that would work. Can you help me out with a drawing again?

KEN—O.K. Let's take negative-going pulses this time. Can you draw the voltage across the resistor?

WILL—Let's see. At the instant the negative line pulse appears, the whole voltage is across the resistor. The charging current that produces it decreases slowly, because the time constant is long, and . . .

KEN—But, my young friend, the charge isn't going to have much time to decrease, because the horizontal pulse itself isn't going to last very long.

WILL—Exactly. After the commencement of the charge, the drop of voltage across the resistor diminishes slightly, then returns to zero at the end of the pulse.

KEN—Are you absolutely sure of that? When the applied signal drops back to zero, it rises E volts. But, since after the beginning of the charge, the voltage on your capacitor has already risen a little toward zero, as you can see from the tips of the first two pulses, it reaches a slight positive value at the end of the pulse. Then the capacitor discharge starts bringing it back toward zero again.

WILL—How complicated can this "most simple" circuit get?

KEN—It's a little simpler than it looks at first glance. You can easily see how the action gets you your vertical field pulse.

WILL—The principle seems to be the same as for line pulses. But the charge lasts a little longer for each individual pulse. And at the end of each, in rising E volts, the voltage across the resistor becomes more and more positive because the capacitor hasn't had time to discharge in the short interval between two successive vertical pulses.

KEN—And the voltages again form a sort of steep stairway . . . ?

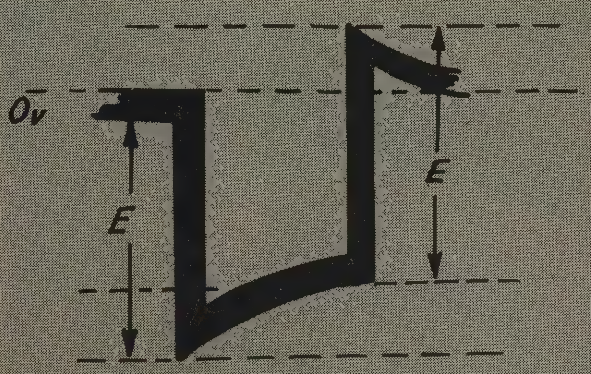
WILL—Exponential, I'm sure! And this lasts till the end of the vertical pulses. Then the capacitor can heave a sigh of relief and start discharging.

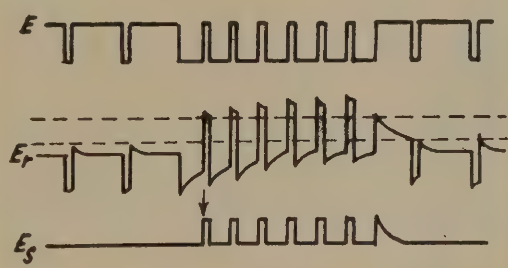
KEN—You see how our long time constant differentiator has succeeded in making the vertical pulses into a series of impulses that rise till they dominate the countryside, figuratively speaking. Now what do we have to do to use them?

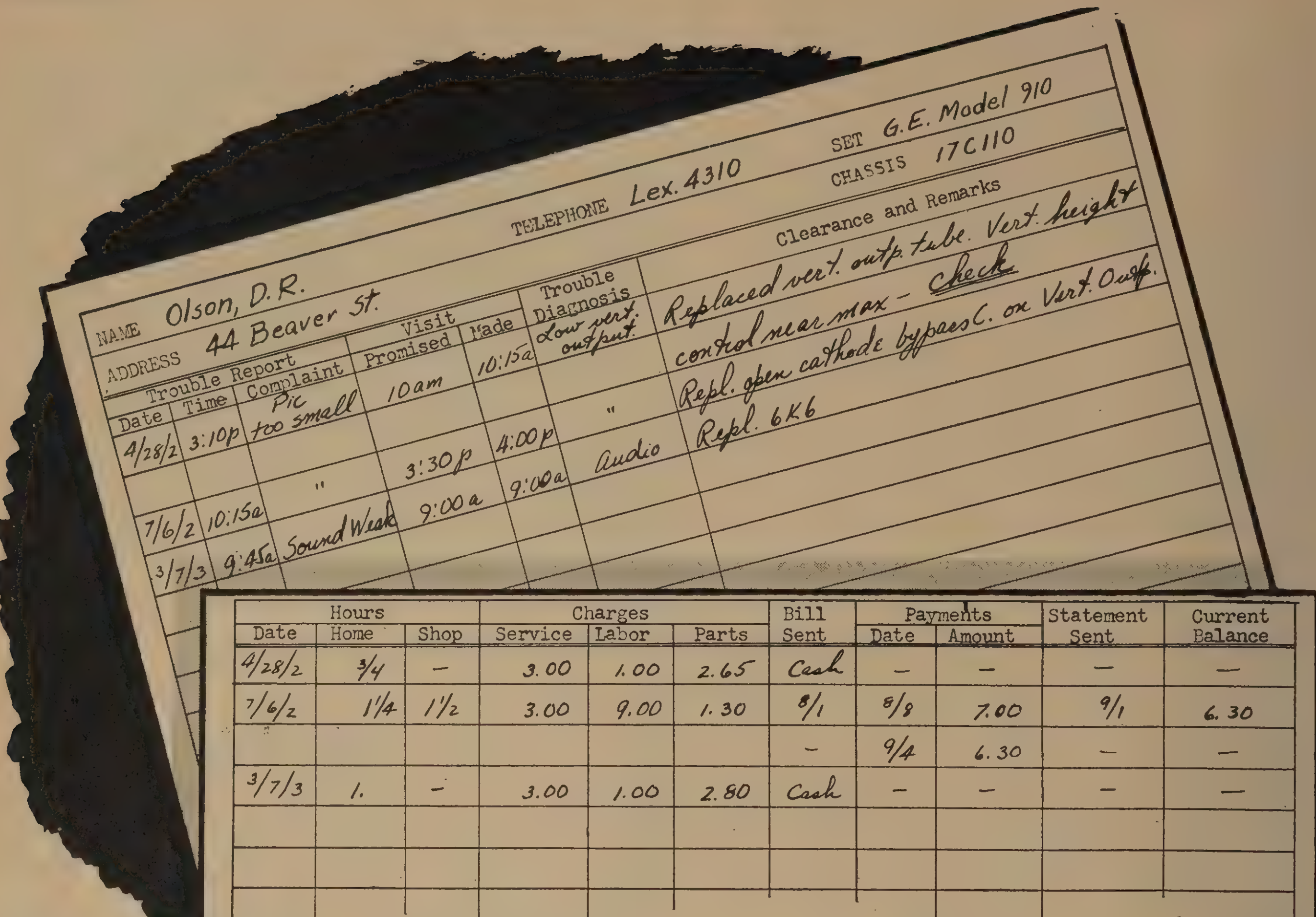
WILL—I guess that if you clipped off everything outside the two dashed lines, you'd get the voltage pulses you've marked E_s. Then you'd use them to synchronize the vertical oscillator.

KEN—Isn't that much neater than the integrator approach? The very first pulse—there, where I've put the arrow—triggers the vertical time- base precisely.

WILL—Ah, well, this timebase I wear on my wrist indicates that it's time for me to go to bed and try to integrate your differential explanations! TO BE CONTINUED







NAME Olson, D.R. TELEPHONE Lex. 4310 SET G.E. Model 910

ADDRESS 44 Beaver St. CHASSIS 17C110

Trouble Report			Visit		Trouble Diagnosis	Clearance and Remarks
Date	Time	Complaint	Promised	Made		
4/28/2	3:10p	Pic too small	10am	10:15a	Low vert. output	Replaced vert. outp. tube. Vert. height control near max - check
7/6/2	10:15a	"	3:30p	4:00p	"	Repl. open cathode bypass C. on Vert. Outp.
3/7/3	9:45a	Sound Weak	9:00a	9:00a	Audio	Repl. 6K6

	Hours		Charges			Bill	Payments		Statement	Current
Date	Home	Shop	Service	Labor	Parts	Sent	Date	Amount	Sent	Balance
4/28/2	3/4	—	3.00	1.00	2.65	Cash	—	—	—	—
7/6/2	1 1/4	1 1/2	3.00	9.00	1.30	8/1	8/8	7.00	9/1	6.30
						—	9/4	6.30	—	—
3/7/3	1.	—	3.00	1.00	2.80	Cash	—	—	—	—

an INDIVIDUAL TV SET TROUBLE RECORD

Improve customer relations and business efficiency with simple system

By HENRY A. AHNEMANN

YOU'VE a lot of faith in the family doctor because he knows every detail of your medical history. If he doesn't actually remember everything, it's all there in his very complete record—complaint, diagnosis, treatment and results — what, when, where and how. Let's see how a similar record can be kept by a service technician and what could be gained from it.

You make a call on a particular customer. We'll assume it is a simple job and that the trouble is cleared by replacing the vertical output tube. The job is handled quickly and efficiently, the charge is nominal, good relations are established and you probably have a new steady client. You notice that the vertical height control is set pretty close to its maximum range. Perhaps another trouble was covered up by the new tube. But, you are busy, the set performs well, and you let it go at that.

A month goes by; you get another call from the same customer and the complaint is the same. During this time you've handled lots of calls and the details of what you found on your first call are rather hazy. The customer undoubtedly will remind you that you were there for the same trouble just a short time ago, but where you do need help your customer won't be of much assistance. However, if you have a record of what you did and noticed on the previous visit, you are in a position to do the job properly. If you find that a new tube again fixes things, you are justified in suggesting that a more careful bench check of the set be made and your records support you and help to explain the situation to the customer. If the customer does not agree, you are protected when the inevitable follow-up call comes along.

Here, then, is the first big advantage of an individual trouble record for each set you service. Your memory is prompted and you are prepared to make your service efficient by supplementing your initial call with constructive work rather than repeating the same jobs. A brief glance at your card while you are making your call will tell you how the set has been performing, how frequently calls have come in and whether there is a possibility that you are overlooking something.

The record can be simple. In fact, the simpler it is the easier it is to maintain. As illustrated, it may be prepared on a 5 x 8 library card and the headings chosen to make it as versatile as you desire. Other jobs that a trouble record can make easier for you are suggested in the following:

Mrs. Olson calls in saying her picture is very small; the sound is fine. While getting the report from her, you reach for the record for this set. On your first call you have entered the information shown on the top of the card illustrated. So you promptly reply, "O.K., Mrs. Olson, our man will be there about 10 A.M. Let's see, you're at

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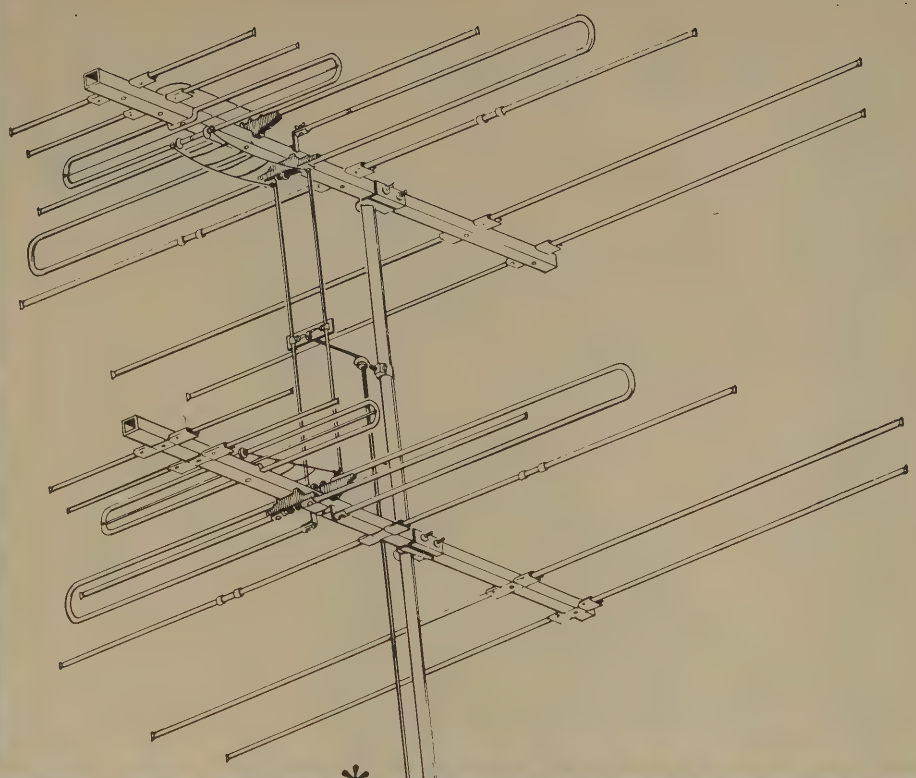

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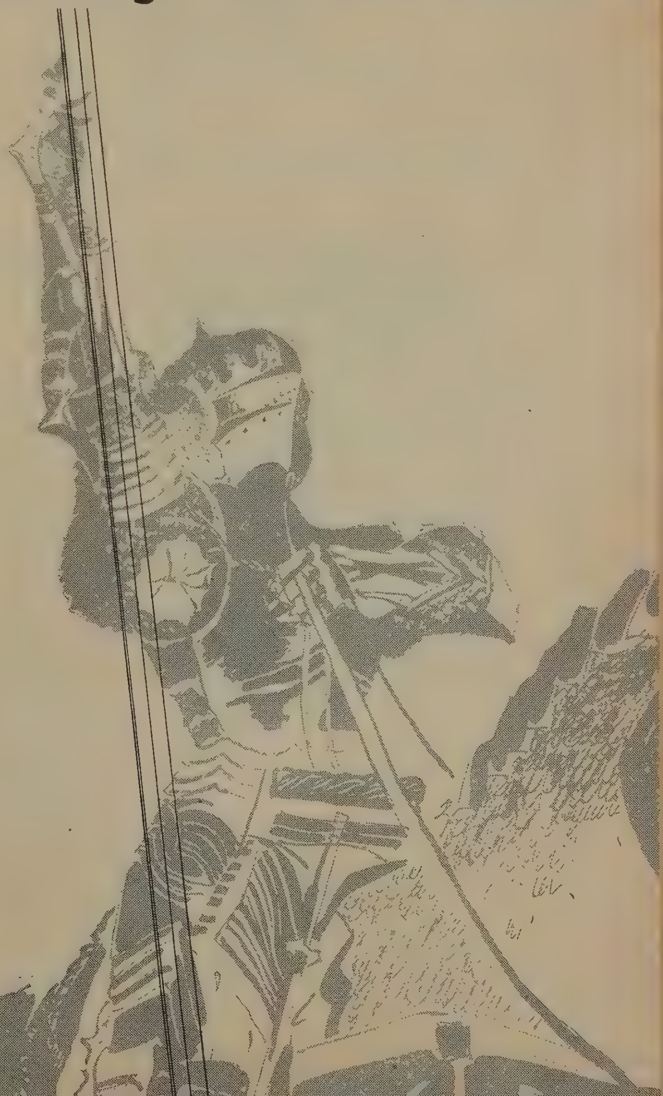


WARD Products Corp., Cleveland 15, Ohio

44 Beaver Street, are you not?—and you have a G-E console? Good. Now if we can't meet that appointment, we'll call you. Your number is Lexington 4310, isn't it?"

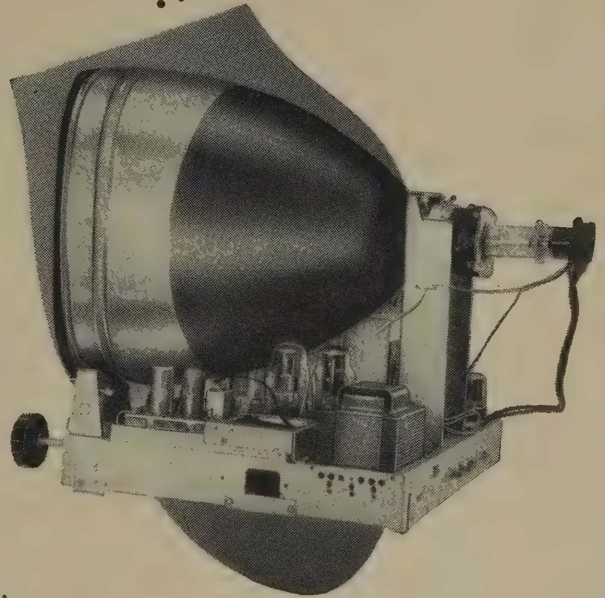
The effect on your customer? It's bound to make her feel that you really are on your toes. And if you take a minute to mention that it's been nearly 8 months since she had trouble, what further evidence does she need of your personal interest in her set? And that minute you spend on good relations isn't an added minute. It's a minute you have saved by not having to again copy down name, address, phone number and the rest.

Another little detail. When you make that first call, record the model number and other details. Check to see if you have that schematic in your file. If you haven't, get it at the first opportunity—it may help get the set into service a day earlier on the next call than if you had to stop to get it. Before you go on a call, take a look at the diagram. It may save you a trip back to the shop for a tube you do not normally carry.

How about measuring your costs, time and net profits? How long is the average service call? How long does it take to clear the average bench job through the shop? Is your service charge adequate to cover this time—can it be reduced to meet competition? How well are you meeting time commitments to customers? What is the average out-of-service time and can it be improved? What's the percentage of call-backs within 10 days? 2 weeks? Does it look as if a little skull session on some techniques or on a particular type of set would pay dividends? These questions and others can be answered if the proper information is entered on the record and a summary prepared. These answers are important for they tell how well you are controlling your business. Once a month is probably often enough to go over the cards and make up a tabulation of the items that interest you. Probably the best time to do this is when you are making your monthly statements.

Speaking of statements—the back of the record card can also be put to good use. As shown in the illustration, a record can be prepared with a few headings that will show hours spent in the field and in the shop, charges for labor and parts and a record of payments. The whole story is on a 5 x 8 card and—if it gets filled up—a couple of strips of cellulose tape applied in the form of hinges, are all that is necessary to attach another card and extend the record.

Finally, don't overlook the advantage of letting your customers see the record. They're sure to be impressed with the detailed information you have about *their* set and they're that much more certain to call you since you are the *one guy* who really knows their set. It may take a little time to organize and set up, but, once its done, the trouble record will pay off. END



Testing Ion Trap Magnets

By JAMES A. McROBERTS and ELLIOTT A. McCREADY

Checking field strength with compass and oscilloscope

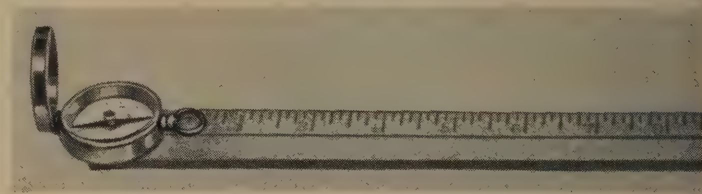


Fig. 1—Basic setup for testing magnets.

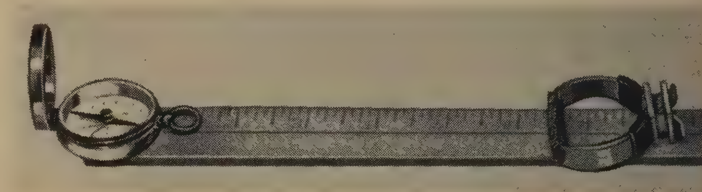


Fig. 2—Magnet is moved toward compass.

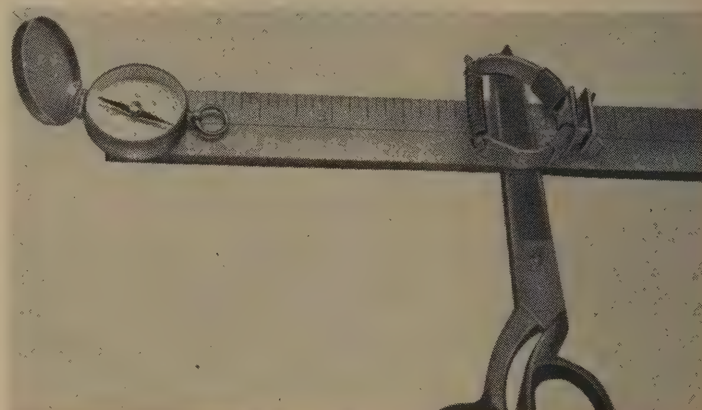


Fig. 3—Scissor forms magnetic shunt.

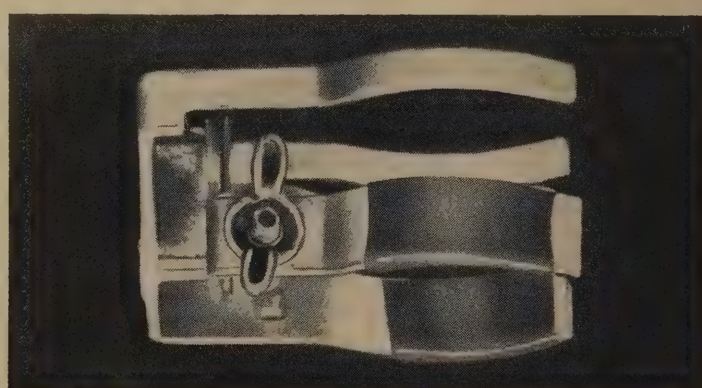


Fig. 4—Single magnet—double poles.

TESTING ion trap magnets in the average shop is limited usually to substituting one magnet for another and observing picture tube performance. This procedure is a very satisfactory method of testing anything—even the kisses of the girl friend.

But perhaps the proper substitute is not available and after purchasing a new magnet, it is found that the original unit is not defective. Time is wasted, and the customer irritated. The simple tests described in this article will indicate the strength of an ion trap magnet (or any magnet).

Wooden magnetometer

A yardstick made of wood (or other nonmagnetic material) and a pocket compass make up the entire bill of materials.

Place the compass on one end of the yardstick (Fig. 1) in a region free of interfering magnetic fields. Move the ion trap magnet being tested from the opposite end of the yardstick, toward the compass (Fig. 2). When there is a measurable deflection on the compass, record the distance from the center of the compass to some point on the ion trap magnet. Use a 10° deflection as a reference.

Any magnetic field acting on the magnetic field of the compass needle will cause it to deflect. The influence of a magnetic field varies inversely as the square of the distance from it. For example, a magnet 5 inches from the compass will produce as much deflection as a magnet 6 inches from the compass, if it is 25/36 as strong.

If you test good magnets as they come into the shop, you will soon collect the needed data on all types of ion trap magnets so that whenever you have a suspected one it will not be difficult to test it immediately and thoroughly.

Be sure to set up the equipment in an area free from magnetic fields. To do so, rotate the compass at the end of the yardstick until the needle points to zero. While keeping the compass fixed with respect to the yardstick, and the yardstick pointing constantly in one direction, move the yardstick in a 6-inch radius circle around its original position. If the needle is deflected more than a few degrees, you will have to search elsewhere for a magnetic dead spot. As a precaution, also move the yardstick vertically. In an ideal position, the needle will maintain its alignment with the yardstick.

Take a good ion trap magnet and move it along the yardstick until a deflection is obtained—do not use over about 20°. The trap in Fig. 2 causes 10° deflection when it is about 8¼ inches from the center of the compass. A small touch of cement holds the compass at exactly zero in this figure. If you wish, use the 1-inch line as the zero point. Note that the pole pieces of the trap point toward the compass; the back of the trap (away from the com-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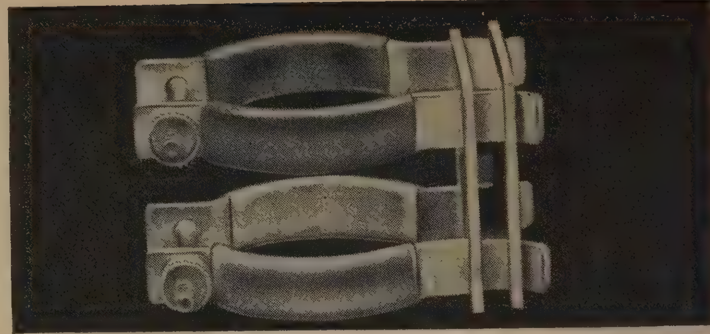

Fig. 5—Double magnet with double poles.

pass) serves as an indicator on the yardstick. The magnetic field of the magnet will produce maximum deflection in this position.

We can simulate a weak ion trap magnet by using the same unit and short circuiting the magnetic gap across the pole pieces with a magnetic material. An old pair of scissors will do (Fig. 3). Now let's try the strength of the magnet on the test rig. You will find that you must move the trap closer (6⅝ inches) to the compass to get the same deflection as obtained previously.

Taking the data from this experiment, square 6⅝ and divide it by the square of 8¼. This gives us about 0.64 or 64%. The single shunt of the scissors has reduced the energy of the magnetic field 36%. Comparative testing of good and bad magnets indicates that a field strength loss of about 30% will result in a very decided loss of brilliance, with a noticeable loss beginning at about 25% of the optimum value. The ratio of the square of the distance from the compass of a suspected trap to that of a good trap should not be less than 0.7. For example, given 5 inches and 6 inches, squaring gives 25 and 36, and dividing 25 by 36 yields 0.695 which is just on the borderline of being bad. Such a trap should be replaced as it will result in a call-back soon, and the picture will be improved by a new trap.

The strength of ion trap magnets required for proper operation of modern picture tubes varies from about 20 to 50 gausses so you should obtain magnets with strengths of 23, 34, 40, 45 and 50 gausses and keep them on hand as comparison standards. *Be sure your standards are O.K.!* Even new magnets may not be what they are rated. Before condemning a magnet as being too strong or too weak, check the C-R tube manual for the correct ion trap field strength. When you have found the required strength, you can be doubly sure by using the correct standard as a temporary substitute.

Take care of PM ion trap magnets. They can be permanently damaged by improper handling or storage. A severe jar or striking it with a metal tool can cause the unit to loose its magnetism and its ability to focus the electrons. Always use a brass or nonmetallic screwdriver when adjusting variable magnets. When storing, do not leave PM ion trap magnets in contact with each other, with metal tools or metal shelving.

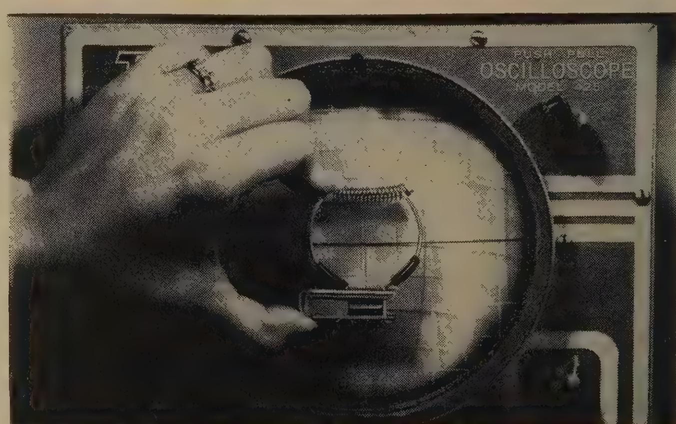

Fig. 6—Positioning the single magnet.

Double magnet traps

Now Figs. 2 and 3 show the single pole piece (rather, pair of pole pieces) magnet. The other types are checked similarly. The pole pieces should always point to the compass when placed on the yardstick. Fig. 4 shows a single magnet type with double pole pieces; Fig. 5, a double magnet type with double pole pieces. It requires a different test.

Place either magnet down, the blue one (blacker or darker in the photo) is on top. Make the same test as for the single magnet type. Now turn the ion trap magnet upside down so that the blue pole piece is on the bottom. The same amount of deflection should be observed, but in the opposite direction

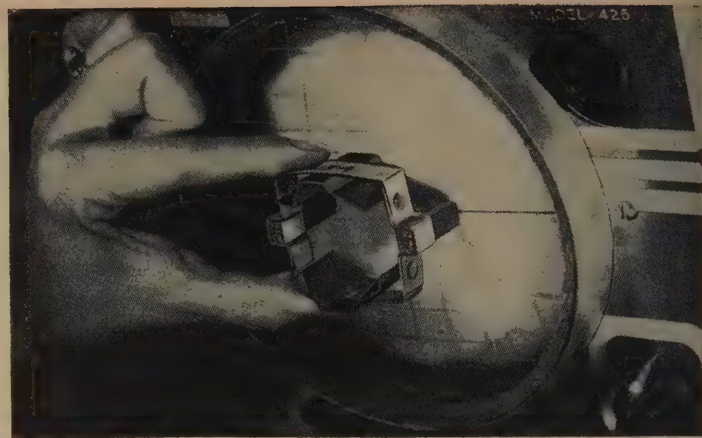

Fig. 7—Positioning the double magnet.

since the magnetic field of the magnet has been reversed. If over ½ inch of movement is required to obtain equal deflections, the magnet should be replaced.

Ring type magnets are tested in the same manner as the open-ended variety with one exception. Bring the magnet near enough to the compass to deflect the needle, and turn it for maximum deflection. The position thus found is maintained during the movement along the yardstick. The position which produces a maximum distance for any type magnet is the one that should be used.

Reject magnets which have to be moved more than 2 inches closer to the compass for standard deflection.

Turn the oscilloscope on, set the vertical gain to zero, and adjust the horizontal gain so the trace covers the width of the screen. Then adjust the vertical positioning control so that the horizontal trace coincides with the center horizontal line on the grid covering the face of the scope tube.

Place the ion trap magnet (Figs. 6, 7) to be tested against the scope tube face so that the field of the magnet is in the same plane as the scope tube face and parallel to the horizontal trace. The result will be a loop in the horizontal trace (Fig. 8). Reversing the ion trap inverts the loop. The height of this loop will depend on the oscilloscope anode voltage, positioning of the ion trap magnet on the tube face, and strength of the ion trap magnet. Horizontal sweep frequency plays no part in the measurement. Positioning of the magnet on the tube face is not too critical and, with a little experience, accurate comparisons between magnets can be made. The photos show correct positioning of some types of traps. Other types should be positioned experimentally.

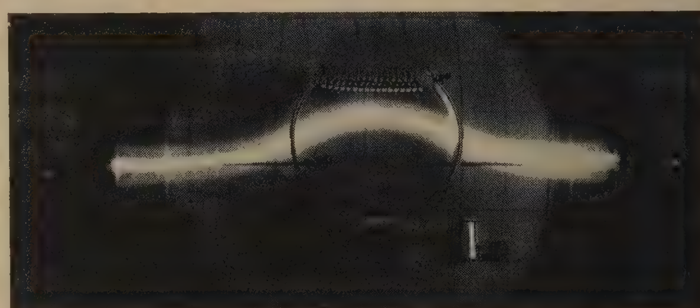

Fig. 8—Deflection produced by magnet.

View with suspicion magnets which require more than 1 inch movement. (Check your compass needle and some good and bad traps for the reject standards, as the magnetic strength of the needle may influence the distance somewhat.) Look down on the needle directly when making readings. A small magnifier may help to read accurately.

Oscilloscope test

One instrument found in almost every service shop can be made to double as a gaussmeter—the oscilloscope. The basic principle of ion trap operation—deflection of an electron beam by a permanent magnet—is the secret of this makeshift gaussmeter. Instead of placing the trap around the neck of the scope tube, the electron beam is deflected at the *face* of the tube. The amount of deflection is a direct indication of ion trap magnet strength. Simple, isn't it?

The best method of calibration is with ion trap magnets of known quality and of the same type as will be tested. An adjustable-strength single ion trap magnet will give an idea of loop height variation with magnet strength. The magnet used in Fig. 6 was adjustable from 32 to 55 gausses. The loop height on my scope varied from ¼ to ½ inch.

A few minutes spent calibrating your oscilloscope, and a check of every ion trap magnet purchased, will insure that your next picture tube replacement won't find you with a dud magnet. END

TV PICTURE SMEAR

By CYRUS GLICKSTEIN

TV picture smear can be produced by a large variety of troubles, originating in different sections of the receiver. To reduce trouble-shooting time, the service technician should be familiar with its possible causes, methods of localizing, and specific remedies.

In smeared pictures, the outlines of large objects are blurred. Large black objects have a trailing white edge and large white areas a trailing black edge. The picture generally has a fuzzy appearance. However, picture smear should not be confused with poor focus, where both the picture and the raster lines on a blank channel are blurred. In a set with picture smear, the raster lines are well focused.

The most common cause of smear is insufficient or excessive low-frequency video response. Incorrect frequency response may originate in any of the three sections (Fig. 1) a video signal passes through before reaching the picture tube: the front end, video i.f. and video amplifier.

Possible causes of incorrect frequency response are: a faulty component (breakdown or change of value in any of the three sections); incorrect alignment (tuner and i.f. section) and incorrect component values in the original design of a new receiver model (usually in the video amplifier stages).

Other possible reasons for picture smear are signal overload at the antenna input, beat-frequency interference causing incorrect fine tuning and sweep circuit pickup in the video output. Smearing may also result from station transmission having a poor low-frequency response.

Each section the video signal passes through is designed to handle signals covering a specific frequency range. The front end must pass both the video r.f. and sound r.f. signals. The bandpass of the tuned circuits in the front end must have the general shape shown in Fig. 2-a and be 6 mc wide. A too narrow r.f. response curve may, when optimum sound is tuned in, attenuate the incoming r.f. video signals. The resultant clipping of the vestigial sidebands reduces the low-frequency response of the receiver.

Incoming signals pass from the r.f. to the mixer stage, where they produce the video and sound i.f. The video i.f. signals (and in intercarrier sets, the sound i.f. signals) pass through the video i.f. section, consisting of three or four stages. The i.f. response curve, Fig. 2-b or 2-c, must pass the full range of video signals up to 4 mc from the video i.f. carrier. In addition, the i.f. response curve must compensate for the vestigial sideband transmission of video signals.

By rotating the fine tuning control past the optimum picture and sound point, the video i.f. carrier can be made to ride higher or lower on the slope. (Rotating the fine tuning control changes the oscillator frequency. This, in turn, changes the video and sound i.f. However, the i.f. bandpass remains fixed by the alignment of the i.f. section.) When the carrier is made to come in at a substantially higher point on the slope, the low-frequency response is increased. At the same time, the high-frequency response is reduced considerably, since the very high frequencies will no longer be within the i.f. bandpass. The result is a brighter, but blurred, smeary picture. The same condition can be caused by incorrect i.f. alignment or a defect in one of the i.f. stages.

When the fine tuning control is rotated in the opposite direction, the low-frequency response is attenuated since the carrier is lower on the slope. The high-frequency response may be increased somewhat. However, more sound i.f. signal passes through the video i.f. section, producing a grainy picture due to 4.5-mc beat interference. The low- and high-frequency response of the video i.f. section can thus be varied to some extent by rotating the fine tuning control past the normal tuning position. This point will come up again later in discussing quick checks for localizing trouble.

The video amplifier section, consisting of the detector and one or two video amplifier stages, should have a relatively flat bandpass (Fig. 2-d) from 60 to 4,000,000 cycles. Many faults (discussed later) can cause poor low-frequency response in this section.

Localizing defective section

When a picture is smeared and sound is normal, the following steps will help localize the defective section:

1. If video overload is suspected, remove one of the antenna lead-in wires. This will greatly reduce the signal input. If the defective picture was caused by overload, the picture will be weaker but less smeared. A more accurate check for overload is to connect an attenuator pad between the lead-in and antenna terminals and note the effect on the picture (Fig. 3). Commercial printed-circuit pads are available in 10-, 20-, 30- and 40-db attentuation values.

2. If the trouble is not caused by overload, note if the large areas become less smeared as the fine tuning control is rotated to one side of the best sound point. If so, the fault is most likely in the r.f. or i.f. section rather than the video amplifier. See also if 4.5-mc beat interference (fine diagonal) lines appear at the best sound point in split-sound receivers. If this happens, there is 4.5-mc interference in the video output. In such cases, the normal tendency is to leave the fine tuning control past the correct tuning point simply to reduce this interference. The fine tuning is left at a point where the video i.f. carrier is too high on the response curve and

(*Continued on page* 93)

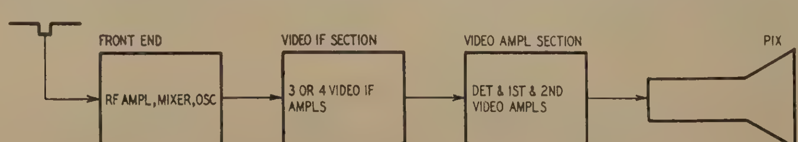

Fig. 1—Video signal path—each section contains a different frequency range.

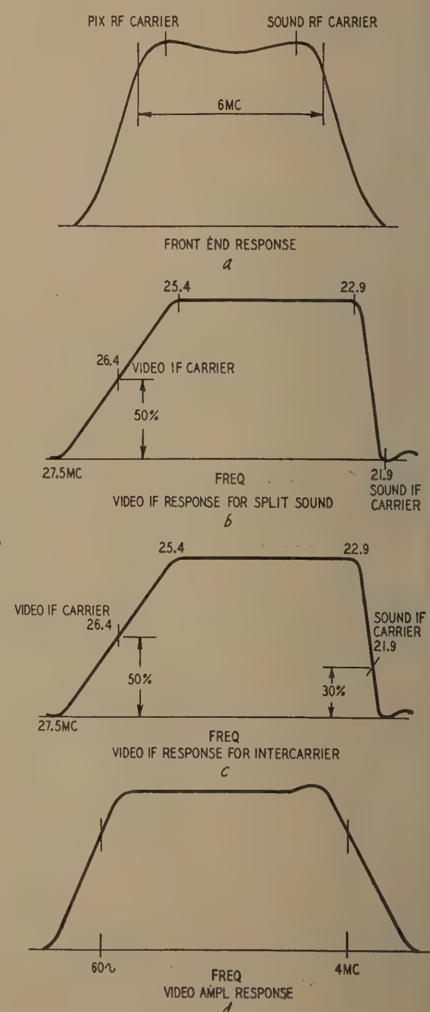

Fig. 2—Ideal TV response curves.

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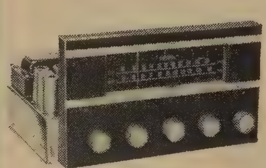

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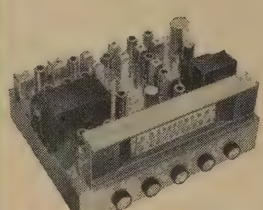

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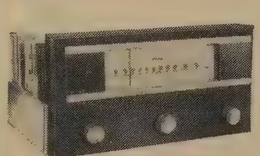

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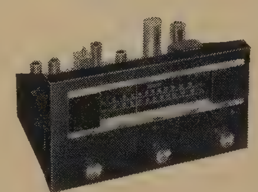

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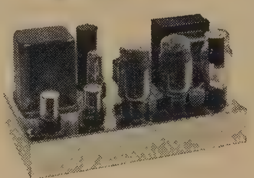

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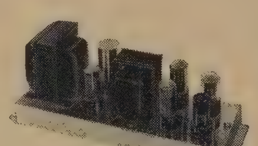

C400 Audio Amplifier

Exceptional performance at low cost. Streamlined narrow chassis for ease of installation. Push-pull 6V6 beam-tetrode tubes plus 13.5 db negative feed back provide 10 watts output with frequency response of 15 to 20,000 cps. (±1 db). Harmonic distortion less than 1%; hum and noise level 70 db below rated output. Five tubes including rectifier. Weight 13 lbs.
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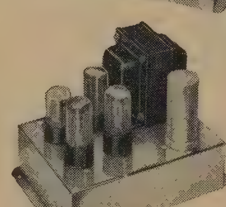

C450 Audio Amplifier

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the sound i.f. carrier (and some of the higher video frequencies) is outside the bandpass. Picture smear, of course, results. Where this occurs, the fault basically is not picture smear but 4.5-mc beat interference. To eliminate the smear, it is necessary to eliminate the interference.

3. If the fine tuning control has to be turned further to bring in a better picture on one or more channels, but reaches the limit of rotation, the r.f. oscillator frequency of that channel must be realigned.

4. Turn the channel selector switch through the range of active channels. If smear is present on only one channel, the fault—if not caused by defective station transmission, overload or incorrect r.f. oscillator frequency in the receiver—is in the r.f. alignment of that channel rather than in the video i.f. or amplifier sections.

5. If smear is noted on all channels and is not improved by a small rotation of the fine tuning control, the fault is most likely in the video amplifier section.

In some cases, the results of these quick checks may be inconclusive. If the receiver is on the bench, an alignment check can be made. The standard method for checking the r.f. or i.f. bandpass is with sweep and marker generators and an oscilloscope, using the same hookup as for alignment. However, a simple check of r.f. or i.f. bandpass can be made with an AM generator and a v.t.v.m.

A frequency response check of the video amplifier section is a more difficult project from the standpoint of equipment needed. The quickest method is to apply a square-wave signal at the video detector load and use a wide-band oscilloscope at the output of the last video amplifier stage. The output waveform is then checked for distortion.

If the r.f. or i.f. bandpass checks indicate a poor response curve, this does not mean realignment is necessary. A defective part may be resonsible for the trouble. If there is some doubt about the defective section, change the tubes in all three video sections. If the trouble is not a defective tube, the i.f. and tuner tubes should be replaced in their original position to minimize any change in r.f. and i.f. alignment.

Other possible troubles and cures in each of the three video sections are:

R.f. section

1. Excessive input at the antenna terminals can cause picture jitter as

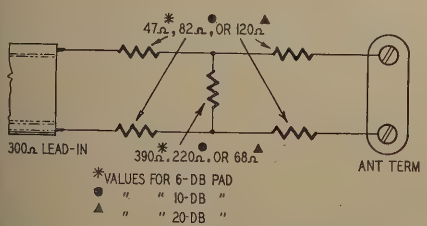


Fig. 3—Signal attenuator network.

well as smear. Overload is not controllable by varying the contrast control, since it occurs in the r.f. stage. To remedy overload, first check the adjustment of the a.g.c. control, if the receiver has one. Where this adjustment does not remedy the condition or no control is provided, an attenuation network should be connected at the antenna terminals. The values for several attenuator networks are shown in Fig. 4. The amount of attenuation needed is determined by the amount of overload. Carbon resistors only should be used.

2. Where a channel is affected because the fine tuning control must be turned to the limit of rotation without tuning in a clear picture, turn the fine tuning to the center of rotation and adjust the oscillator slug.

3. A complete r.f. or i.f. realignment should be undertaken only when the need has been definitely established—that is, when there is no defective part and the bandpass curve is completely off. If only a small portion of the bandpass curve is beyond the acceptable tolerance, as determined by an v.t.v.m. or sweep generator check, a complete realignment is usually not necessary. Note which part of the bandpass curve is off the most. Check the schematic and the manufacturer's alignment instructions to determine which adjustment has the most effect at that frequency. Then make the adjustment slowly while watching the picture. In any touchup procedure, it is always a good policy to note the starting position of the slug slot and to count the number of times the slug is turned. In this way, it is always possible to return to the starting position if rotation of the slug in either direction does not remedy the fault.

Where a complete realignment is required, an accurate AM generator can be used to peak adjustments at the correct frequency in stagger-tuned i.f. stages, but overall alignment should be checked by a sweep generator and accurate marker frequencies. The manufacturer's specifications should be carefully followed when a complete realignment is made. These specifications usually include techniques that vary slightly with the various models.

I.f. section

1. Open screen, cathode bypass or decoupling capacitors or defective plate, screen or cathode resistors can reduce the gain of an i.f. stage. This affects the i.f. response curve most at the frequency to which the particular stage is tuned. When a check of the i.f. bandpass shows a fault in a given part of the curve, check those stages responsible for that portion of the response curve. Check also for a defective coil in the stage's tuned circuit.

2. Where aging of components results in a need for realignment, check whether a complete realignment is necessary.

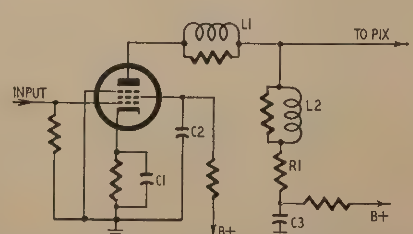


Fig. 4—Typical video amplifier stage.

Video amplifier section

The following faults in this section can cause picture smear:

1. Incorrect values of coupling capacitors. A direct-coupled video amplifier does not necessarily guarantee good low-frequency response.

2. Incorrect values of cathode bypass (C1) and screen bypass (C2) capacitors in the video amplifier (Fig. 4) stages. An open decoupling capacitor (C3) increases the effective value of the plate load resistor.

3. A defective load resistor (R1) in the video amplifier or video detector stage can cause poor definition, smearing, poor contrast or poor sync stability. When load resistors in this section increase in value, the stray capacitance in the load circuit shunts a larger proportion of the higher video frequencies around the resistors. In effect, the high-frequency response of the circuit is reduced greatly while the low-frequency response is boosted. The picture accordingly loses detail and may become smeared.

4. A 4.5-mc beat in the picture can be minimized by detuning the fine tuning control. If the set has one, retune the 4.5-mc trap for minimum interference. In some cases, it may be necessary to install a 4.5-mc trap between the plate of the output video amplifier and the C-R tube.

5. Open peaking coils (L1 and L2 in Fig. 4).

6. Defective video detector crystal.

7. If the hot horizontal deflection yoke lead is dressed too close to the picture-tube video (cathode or grid) lead, horizontal voltage pulses can be coupled to the picture-tube input. This may cause the picture tube to draw grid current. To avoid this, dress the two leads away from each other but not near the vertical deflection leads.

Where the low-frequency response of a new receiver is below par, it is usually helpful to check the field service bulletins of the manufacturer. Typical suggestions for improvement include:

1. Add a 1,500- to 4,700-$\mu\mu$f capacitor across the previously unbypassed cathode resistor of the video amplifier.

2. Change the peaking coil in the grid circuit of the first video amplifier from 120 to 500 μh.

3. Dress coupling capacitor leads in the video amplifier section away from each other.

4. Increase the value of coupling capacitance between stages in the video amplifier section up to a maximum of 0.22 μf to increase the low-frequency response. END

TRANSISTOR RADIO uses NO POWER SUPPLY

Here's what many have looked for—something for nothing

By WILLIAM H. GRACE, JR.

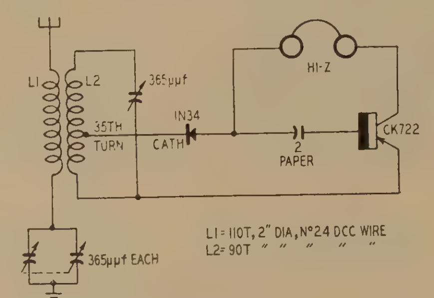
RECENT statistics on the sales of crystal receivers plus the sales of radio parts for such sets to hobbyists indicate that there may be approximately a quarter of a million such receivers in use throughout the world. One manufacturer reports sales of 50,000 crystal sets during 1954. The reasons are cheap and dependable reception, good fidelity, low initial cost and next to no upkeep expense. The main disadvantage of crystal receivers is the low sound volume in the headphones or speaker. This deficit could be remedied by a stage of tube or transistor audio amplification but this requires some external source of power.

The circuit described in this article provides a stage of transistor audio amplification of moderate gain without requiring any external power source of a conventional type whatever. I originated the circuit several years ago while experimenting with standard audio circuits and it has proven itself practical and effective.

This circuit comes as close to giving something for nothing as you are apt to see in a long time. Because of this characteristic, it seemed to be just naturally wedded to a crystal receiver.

If you live in a location where a crystal receiver will provide a good signal, this battery-less transistor amplifier will almost double the volume. The crystal tuner (see diagram) is the conventional tuned-primary–tuned-secondary affair used for years by crystal experimenters and before that by ship-to-shore stations in the days of spark transmitters. A 1N34 germanium diode is used as a detector–rectifier. Any suitable type of diode may be substituted in place of the 1N34, and one of the newer gold-bonded silicon types having lower front and higher back impedances might well prove superior to the germanium ones.

The audio stage requires but two additional parts, a Raytheon CK722 or similar junction transistor, and a fixed capacitor whose actual value appears not too critical. Almost any value between .05 and 5 μf will suffice. I used a miniature 2-μf paper capacitor because it was at hand and functioned satisfactorily. The operation of the amplifier is extremely simple. It depends upon the fact that the output of the diode consists of two separate components—the modulated signal current and the rectified carrier d.c. This d.c., useless in the ordinary crystal receiver, is applied to the collector of the transistor and powers the audio stage. In other words, the rectified carrier current is put to work in the collector circuit to increase the signal current from the diode.



Schematic of the battery-less amplifier.

If your crystal set has an output of around 100 microamperes (measured across the phone jacks), worth-while amplification will be obtained from this system. If an output of 500 or more microamperes can be obtained, considerably greater volume will result. The louder the signal to begin with, the greater will be the usable d.c. from the carrier and the greater the gain.

The polarity of the diode is most important. If it is reversed, there will be no amplification. The polarity shown in the diagram is correct for use with the CK722 or other transistors of the p-n-p type. These transistors require a negative collector. If a transistor of the n-p-n type is used, the diode will have to be reversed because, in this case, the collector will have to be biased positively.

The amount of amplification or gain from an amplifier of this type is not equal to that of one using an external source of d.c. power plus proper emitter bias, but sufficient gain is obtained on strong local signals to produce very high headphone volume. In strong field-strength areas moderate speaker volume can be realized with only the single stage of audio. Various modifications of the circuit, such as using transformer-coupled arrangements, proved successful. I found it practical to take the rectified carrier d.c. from a frequency other than the one that furnishes the signal current. Test various types of transistors in this basic circuit; the resulting gain depends to a considerable extent upon the characteristics of the particular transistor used. However, the CK722 type will function well and is among the least expensive of the models now available to the builder. This "something-for-nothing" circuit is almost foolproof. END

Parts for battery-less amplifier

1—high-impedance headphones; 1—CK722 transistor; 1 — 1N34 crystal; 1 — 2-μf capacitor (see text); 1 — 365-μμf tuning capacitor; 1—2-gang tuning capacitor, 365 μμf each; 1—primary coil (L1), 110 turns, 2-inch diameter, No. 24 d.c.c. wire; 1—secondary coil (L2), 90 turns, 2-inch diameter, No. 24 d.c.c. wire, tapped at 35th turn from the low end.

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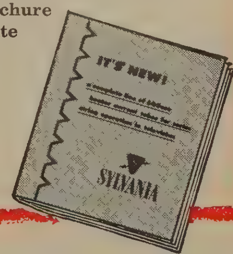

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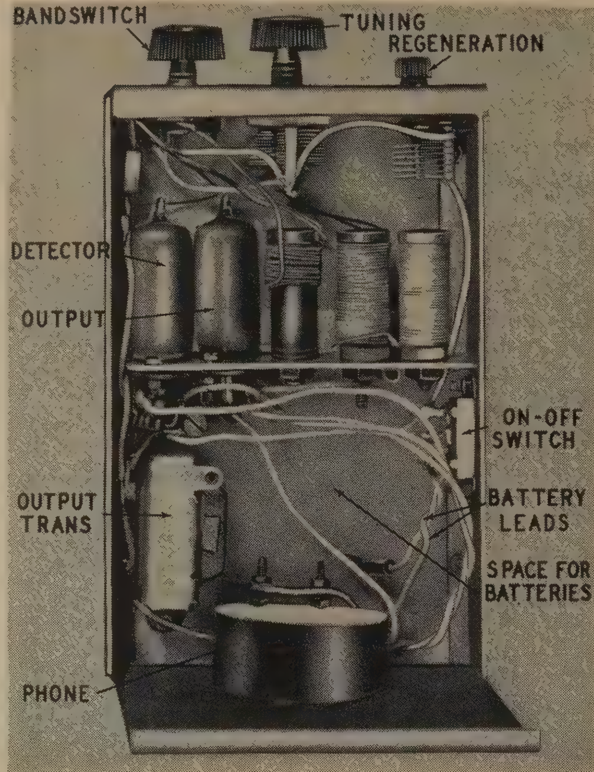
EMERGENCY RECEIVER

By T. W. DRESSER



A view of the 6½ x 3½ x 1½-inch chassis with the cover removed to show the insides. A single phone is in the cover. Set is held to the ear when in operation.

SOME time ago—September, 1951—in an editorial, Hugo Gernsback called attention to the need for a portable radio, light in weight, capable of being carried in the pocket, yet robust enough for use in emergencies such as heavy bombing raids. Here in Britain we suffered such need in the last war. In the writer's home town 87,000 houses out of a prewar total of 92,000 were damaged or destroyed and the death toll ran into four figures. We know the wisdom of his words. Living under the constant threat of invasion and with our electricity frequently cut off for long periods it was essential that a reliable means be found to insure reception of the news. That could mean only one thing—battery radio. As most nights were spent in air-raid shelters, the radio had to be small and portable.

The primary aim in designing such a radio is to make sure of good signals from at least Home stations. As broadcast stations are no less vulnerable to bombing than homes or factories, it is not considered advisable to rely solely upon the local station or upon one band. Because it was known that no British short-wave station suffered damage from bombing—probably due to their isolated locations—our home-constructed miniature portables were generally designed to cover short waves only, or a section of the broadcast band plus short waves from 12 to 70 meters.

The first receiver we built was a single-tube effort—for short waves only—using a standard arrangement (Fig. 1) of regenerative detector and audio amplifier. A 3A5 fulfilled both purposes, transformer coupling being used between the two sections to increase gain. The output can be taken to a 2-inch speaker, but a single earphone was used in preference, being lighter in weight and eliminating the need for an output transformer. The unit was built into a case made of 16-gauge aluminum, measuring 6 x 4 x 1.5 inches. It was powered by a 3-volt A battery, 3-volt bias battery, and two 22.5-volt B batteries in series, all being featherweight or hearing-aid types. Miniature type parts were used throughout, including the earphone, and the coils were plug-ins (Table 1).

This receiver tuned from 15 to 42 meters and 38 to 75 meters in two bands. With a 30-foot length of thin, rubber-covered, flexible wire as antenna, it gave excellent results on Home stations and good results on signals from the United States, Canada, Belgian Congo, and as far away as the Dutch East Indies.

Arising from the experience with this receiver, a more ambitious project was started early in 1942. By this time the majority of such radios had resolved themselves into some variation of the Hartley circuit. The reason for this choice was fairly obvious. The arrangement was probably the most efficient there is, for simple t.r.f. circuits of this kind. It provides excellent performance on both short-wave and broadcast bands, whereas the magnetic feedback circuit of Fig. 1, while O.K. on broadcast bands, has a tendency to make the tuning rather critical on short-wave. The Colpitts circuit has a big drawback in its use of series tuning capacitors, although in all other respects it is quite good. The only objection to the Hartley is that both sides of the tuning capacitor are hot to r.f., consequently, hand capacitance would affect tuning badly unless precautions are taken. This can be done by using an insulated shaft and a coupler between the control knob and the capacitor shaft proper.

The receiver, built on these lines and still in use today, weighs 17 ounces and can be carried in most coat pockets. The schematic is shown in Fig. 2 and incorporates many of the ideas used in the previous model. Transformer coupling is again used and a single earphone replaces a

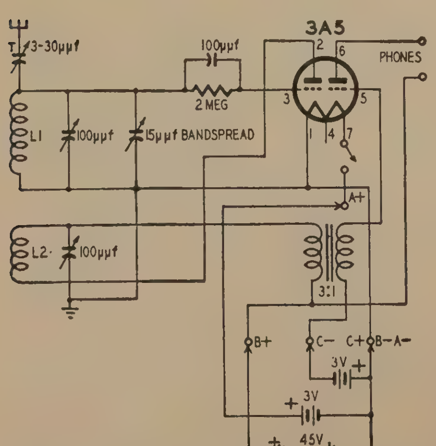


Fig. 1—Emergency portable receiver.

TABLE 1—Specifications for Fig. 1 Coils

Band	L1	L2
15-40 Meters	13 T spaced to 1¼ inches.	4 T close-wound, ⅓ inch from ground end of grid coil.
40-75 Meters	23 T spaced to 1⅜ inches.	6 T close-wound, ⅛ inch from ground end of grid coil.

Both coil forms 1-inch diameter, and all windings with No. 24 wire.

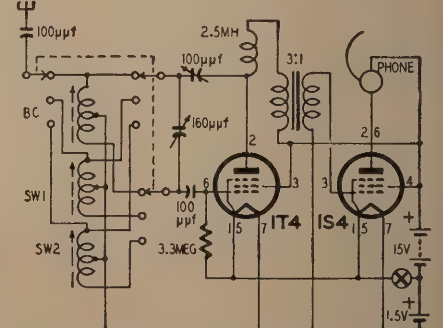
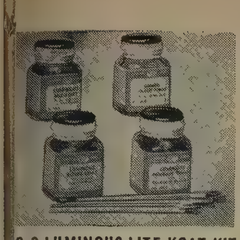


Fig. 2—Improved emergency portable.



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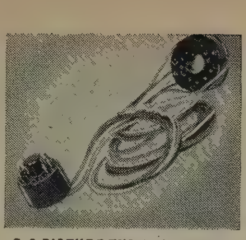

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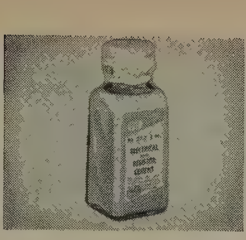

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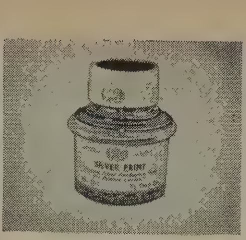

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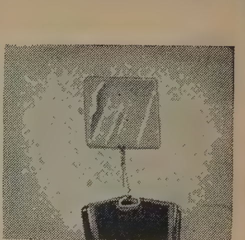
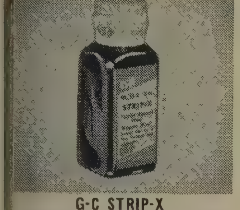


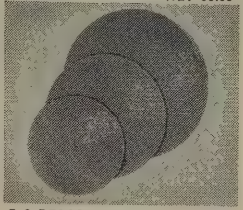
G-C TV PORTO MIRROR
Heavy chrome plated mirror for adjusting TV sets. Rubber lined spring clamp.
No. 8198 NET $2.58



G-C STRIP-X
Removes insulating enamel from wires for easy soldering. Simply dip and wipe!
No. 26-2 2 oz. bottle NET $0.39

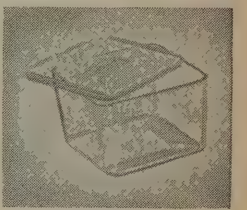
G-C CREME-O-WAX POLISH
White, non-staining polish for furniture, TV and radio cabinets. Dries to hard gloss.
No. 95-16 16-oz. bottle NET $0.66

G-C CABINET REPAIR KIT
Contains 10 shades of shellac sticks, stains, varnish, brushes, everything for cabinet repairs. Easy to use.
No. 901 NET $4.50



G-C RECORD TURNTABLE FELT
Ready-cut replacements, center hole.

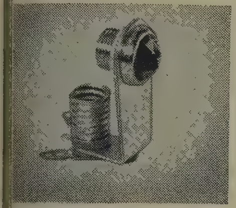
No. 1292	7⅞" dia.	NET $0.30
No. 1293	9⅞" dia.	.42
No. 1294	11⅞" dia.	.51



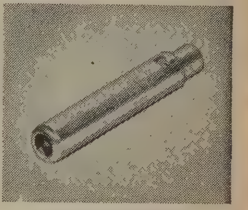
G-C PLASTIC STOCK BOX
Handy, covered polystyrene box for stocking screws, nuts, resistors, capacitors, etc. 4x4x2½.
No. 8022 NET $0.36

GENERAL G-C CEMENT

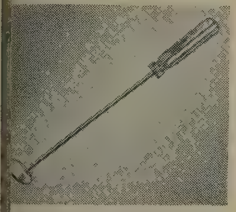
Ask For These RADIO-TV SERVICE AIDS *...at Your Jobber*



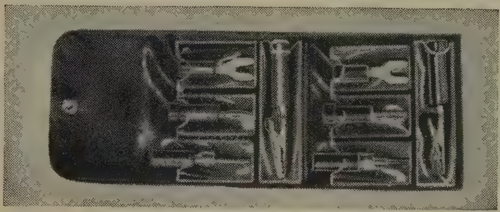
G-C ½" JEWEL SIGNAL LIGHT
Miniature screw base jewel in red, green, blue, amber, opal, clear (specify). 7⁄16" mtg. hole.
No. 7910 NET $0.27



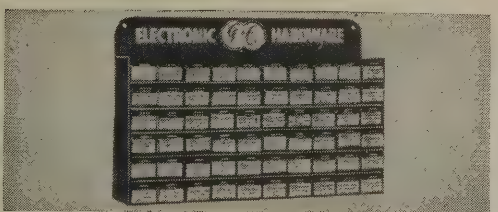
G-C FUSE CONNECTOR
Regular type used on car radios, etc. 2½" long x ⅜" dia. For ¼" fuses.
No. 1749 NET $0.15



G-C INSPECTION MIRROR
Get into those hard-to-reach corners, inspect coils, connections, etc.
No. 5090 NET $0.33

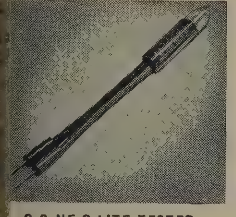


G-C TEST LEAD PLUG INTERCHANGE KIT
Easy to switch alligator clips, banana plugs, spade lugs, phone tips. Fitted plastic case holds one each in red and black.
No. 7743 NET $1.95

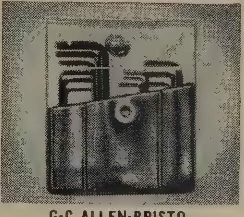


G-C ELECTRONIC HARDWARE LAB
Contains 60 most popular items in G-C 50 Line, each in hinged cover box. Good looking steel rack (9" x 13½" x 2½") for bench or wall mounting included in kit without charge.
No. 3660 NET $19.50

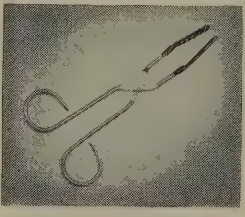
G-C SWEDISH STEEL SHIMS
Leatherette kit includes 16 high grade shims for speaker repair. Sizes: .004", .006", .008", .010".
No. 701 NET $0.54



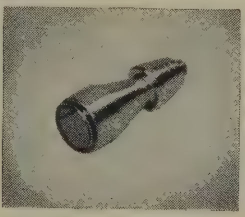
G-C NE-O-LITE TESTER
Neon glow lamp circuit tester for many uses. 60 V. AC to 550 AC-DC.
No. 5100 NET $0.36



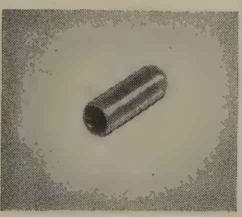
G-C ALLEN-BRISTO WRENCH KIT
Complete kit for both hex and spline type screws. Leatherette case, 12 wrenches.
No. 5028 NET $1.08



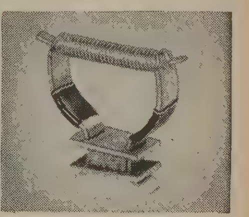
G-C TUBE & PARTS EXTRACTOR
Originally designed for Signal Corps. Spring steel, cadmium plated. Prongs rubber cushioned.
No. 5092 NET $0.99



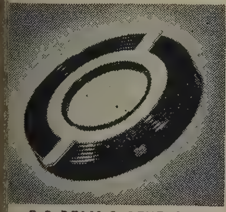
G-C MINIATURE TUBE PULLER
Suction, vacuum principle tool prevents tube breakage, burned fingers. Easy to use, saves time.
No. 5093 for 7-pin tubes NET $1.08
No. 8106 for 9-pin tubes 1.08



G-C UHF HOLLOW LINE CAPS
Seals round and oval hollow line ends. Easy to slip cap over end of line, eliminates heat sealing.
No. H8912 Box of 8 NET $0.30

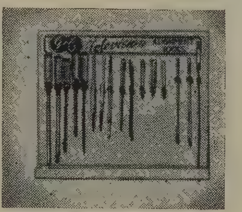


G-C BO ELIMINATOR
Eliminates Barkhausen Oscillation in horizontal sweep output tubes. Easy to install and adjust.
No. 8749 NET $0.75



G-C BEAM-O-CENTER
Beam adjuster fits in back of tube yoke coil to center picture. Bakelite housing. Easy adjusting.
No. 8956 NET $1.05

G-C TV HIGH VOLTAGE PLIERS
Insulated long nose pliers made of high impact Bakelite. Absolutely shock-proof.
No. 8387 NET $0.99

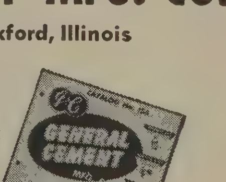


G-C ALIGNMENT BENCH KIT
Includes 16 most needed tools in handy stand-up bench rack.
No. 8281 NET $7.74

GENERAL CEMENT MFG. CO.

910 Taylor Ave. • Rockford, Illinois

FREE! Postcard brings your big G-C Catalog.



Ask Your Jobber for the G-C **SPECIALS OF THE MONTH**

G-C ALIGNMENT TOOL KIT
No. 9200
NET $13.95

G-C ALIGNMENT TOOL KIT
No. 9201
NET $14.95

1930-1955 25th Anniversary GENERAL CEMENT MANUFACTURING COMPANY G-C TELCO

speaker for output. Two tubes are used in this version, a 1T4 regenerative detector and a 1S4 audio amplifier. Power comes from a 1.5-volt A battery and a 22.5-volt B battery (Fig. 2 shows a 15-volt battery, but 22.5-volt unit gave better performance), both featherweight types. Three bands are covered, 250-480, 25-55 and 12-25 meters, with slug-tuned coils (Table 2). Controls are kept to a minimum, as too many knobs to twist can be a nuisance under blackout conditions. As with the first one, all components are miniature types including the audio transformer which measures 1 inch each way (a hearing-aid type, if available, would be ideal).

The chief claim to unorthodoxy in this little radio and the secret of its excellent performance lies in the use of a high L/C ratio on all bands. For

TABLE 2—Specifications, Fig. 2 coils.

Band	
BC	162 turns tapped at 112 from bottom. No. 38 enameled
SW1	30 turns center-tapped. No. 30 enameled.
SW2	12 turns center-tapped. No. 24 enameled.

reasons connected with coverage, this is not usual on the broadcast band. But, as it enables a gain of some 25 db greater than that from a normal input arrangement.

In all other respects the circuit is quite standard, and in many cases, the few parts required will be found in the junk box. No particular instructions are necessary in regard to building beyond saying that with both receivers, the wiring should be kept as short as possible. 25 or 30 feet of

Parts for receiver in Fig. 1

Capacitors: 1—3-30 μμf, ceramic, mica or air dielectric, 1—15, 2-100 μμf, air, variable. 1—100 μμf, fixed, mica or ceramic.

Miscellaneous: 1—2-megohm resistor, 1—3-to-1 single-ended a.f. interstage transformer, 1—3A5 tube. Socket, dials, chassis, phones, phone jack, batteries, terminal strips, hookup wire, 2—1-inch diameter plug-in-coil forms, No. 24 wire for coils.

Parts for receiver in Fig. 2

Capacitors: 1—100, 1—160 μμf, variable, 2—100 μμf, fixed mica or ceramic.

Miscellaneous: 1—2.5-mh r.f. choke, 1—3.3-megohm resistor, 1—3-to-1 single-ended a.f. interstage transformer, 2—7-pin miniature tube sockets, 1—1T4, 1—1S4 tube; 1—2-pole, 3-position rotary switch, 1—s.p.s.t. toggle, slide or rotary switch; batteries, headphones or single earphone, hookup wire, No. 24, 30 and 38 wire for coils, chassis, and hardware.

rubber-covered, flexible wire makes a good antenna when flung over a tree, or wall, or even laid out on the ground, and can be wound round the case when not in use. The ground connection is 3 or 4 feet of the same material with a crocodile clip on the free end, which can be clipped to any ground point, or left trailing.

In conclusion, both these receivers, originally designed for serious purposes and still having that purpose in mind, will prove useful items to take along on vacation or camping trips, and will provide plenty of entertainment, especially for short-wave enthusiasts. END

new Devices

NEW SECRET RECORDER camouflaged in average-size leather briefcase which may be opened, carried or put down without revealing recorder. Weighs 11¾ pounds; measures 16 x 4¼ x 12½ inches. After

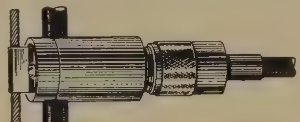
level has been preset, no further adjustments required. Automatic volume control equalizes nearby and distant sounds. Built-in microphone picks up whispers in quiet area at distance of 12 feet, ordinary speech at 100 feet. Combination slide lock and start-stop switch. Continuous recording for 1¼ hours at tape speed of 1⅞ i.p.s. using long-play ¼-inch magnetic tape; a 5-inch reel holds 3 hours of dual-track recorded material. Built-in preamplifier for headphone playback. Output into external amplifier and loudspeaker for greater playback volume.—**Amplifier Corp. of America**, 398 Broadway, New York, N.Y.

LONG-PLAYING TAPE, *IRISH LP 600*. Frequency response limited only by recording and playback equipment with 50% increase in playing time over standard tapes on same reel. New *Ferro Sheen* process for wider frequency range, less

background noise, greatly reduced dropout, higher fidelity, no needle noise, no deterioration in quality on repeated playing. Available in either 1-mil acetate or 1-mil Mylar.—**ORRadio Industries, Inc.**, Opelika, Ala.

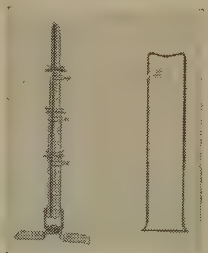
TV CABLE TAPOFFS, *Blonder-Tongue Masterline* series *model MTO-11* for community systems; *model MTO-59* for indoor use. Air dielectric insulation minimizes shunt capacitance. Uniform 17-db r.f. isolation, positive electrical protection through spring-contact resistor-capacitor network.

MTO-11 handles RG-11/U



through-line, with clamp for messenger cable and RG-59/U fitting for tapoff line. *MTO-59* taps into RG-59-U for TV outlets in hotels, apartments, etc. Wall outlet plate and RG-59/U receptacle included. Each tapoff has less than ½-db insertion loss.—**Blonder-Tongue Laboratories, Inc.**, 526 North Ave., Westfield, N. J.

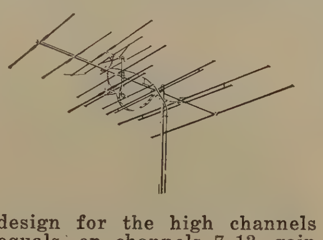
TELESCOPING MASTS, *Jontz Kwick-Up* deluxe *100 series*, made from hot-dipped galvanized tubing. Standard *200 series* of tubing rolled from galva-



nized strip. Various o.d. sectional combinations. Mast sections will not pull apart; locking device enables speedier erection and locking without tools; guy ring; companion base to assure definite locking and eliminate turning in the wind.—**Jontz Mfg. Co.**, 1101 E. McKinley Ave., Mishawaka, Ind.

YAGI ANTENNA, *LaPointe VeeDXer*, all-channel v.h.f. type. High gain. High front-to-back ratio eliminates co-channel interference.

Yagi 18-element combines half-wave broadband Yagi on the low band with full-wave broadband Yagi on high. Phased together with VEE-D-X Dyna-phase system. Full-wave

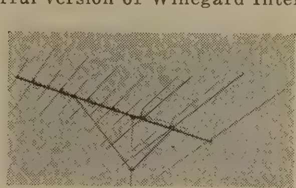


design for the high channels equals, on channels 7–13, gain directivity and front-to-back ratio of single-channel 10-element Yagi.—**LaPointe Electronics Inc.**, Rockville, Conn.

FRINGE ANTENNA, *Ward Invader*, has flat type Inline Yagi for operation in fringe areas in v.h.f. range and in primary signal areas in u.h.f. range. Snap-lock bracket eliminates intermittent contact. Requires only 29

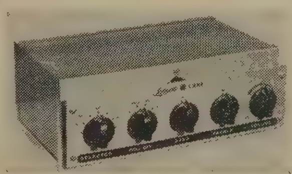
inches of stacking. Available in 4-bay stacking kit, *model TV-357*, and two-bay version plus stacking harness, *model TV-356*.—**Ward Products Corp.**, Division of Gabriel Co., 1148 Euclid Ave., Cleveland 25, Ohio.

NEW ANTENNA, *Winegard Super 'Ceptor SL-4*, a more powerful version of Winegard Inter-



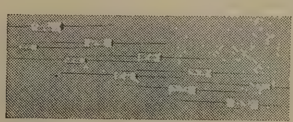
ceptor for difficult and extreme fringe TV areas. Multielement Yagi performance on all 12 v.h.f. channels. Modified Tee-matched driven elements phased to reinforce signals from front and cancel from back and sides. Uniform gain characteristics, absence of resonant peaks and suck-outs and high signal-to-noise ratio qualify antenna for color reception.—**Winegard Co.**, 3000 Scotten Blvd., Burlington, Iowa.

NEW AMPLIFIER, *Lafayette LA-54*, furnishes 12 watts. Frequency response, 20–20,000 cycles. Includes record equalizer with separate adjustable-base



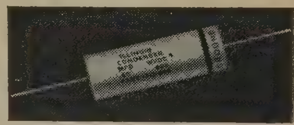
turnover and treble rolloff; 16 playback characteristics; phono preamplifier; input for crystal, ceramic cartridges; special recording tape takeoff jack; FM (capacitance) input; good power output at very low and very high frequencies.—**Lafayette Radio**, 100 Sixth Ave., New York 13, N. Y.

PAPER TUBULAR CAPACITORS, *Cornell-Dubilier STT Midget Budroc*. Miniaturized versions of *Budroc* capacitors. Size range from 7/32 inch diameter and 11/16 inch length to ⅜ and 1⅛ inches, respectively. Rated up to 400 volts



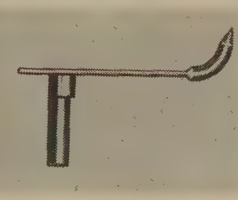
d.c.: impregnated in HT compound; operating temperature range from −40° to +90° C. Rated at 600 volts d.c.: impregnated in Vikane; operating temperature range from −55° to +100° C.—**Cornell-Dubilier Electric Corp.**, South Plainfield, N. J.

CAPACITORS, *Illini Ste-Tite*, have very high insulation resistance, low power factor, long-life performance at high temperatures. Noninductively wound foil assemblies oil-impregnated and hermetically sealed in steatite cases. Over-



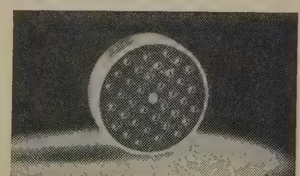
load tested, standard tolerance ±20%. Thermoset end seals will not soften or flow with soldering or at any conceivable operating temperature. Available in capacitance ranges from .0005 to 1.0 μf and in 200, 400, 600 and 1,600 working volts d.c. ratings.—**Illinois Condenser Co.**, 1616 N. Throop St., Chicago 22, Ill.

PICKUP CARTRIDGE, *Astatic* crystal phonograph types. *Model 66 series:* 3-volt output at 1,000 cycles, 1-megohm load; *68 series:* 4-volt output. Both types in single and double-needle turnover models. High compliance of model K needle, illustrated below, results in true tone, smooth response and absence of needle talk. Single-needle models: 1-mil needle tip



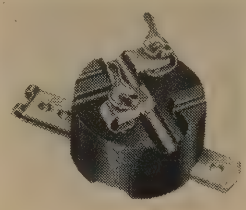
for slow-speed records; 3-mil, 78 r.p.m.; 2-mil, all record grooves. Easily replaceable without tools. Housings are stamped aluminum; terminals quick disconnect type. Crystal elements have moistureproof coating.—**Astatic Corp.**, Conneaut, Ohio.

MICROPHONE CARTRIDGES, *Ronette Filtercel*. Sensitivity at 1,000 cycles of 2.2–2.6 millivolts per μbar, eliminating need for high-gain preamplifier. Range: 30–7,500 cycles. Available with almost any variation in frequency response desired.—**Ronette Acoustical Corp.**, 135 Front St., New York 5, N. Y.



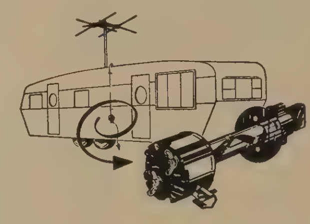
LIGHTNING ARRESTER, *Radion LA75*, handles all standard types of 300-ohm lead (open, jumbo, flat, tubular). UL approved for outdoor and indoor use. Utilizes sparkgap,

resistor circuit (technically safest). Includes mounting strap and hardware; features



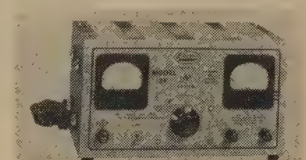
Radion ground wire grip.—**The Radion Corp.**, 1130 W. Wisconsin Ave., Chicago 14, Ill.

LIGHTNING ARRESTER and lead-in tube, *Telco 8644*, for mobile home television installations. Can be installed in ¾-



inch hole in trailer wall and lead-in tube pushed through the hole.—**Television Hardware Mfg. Co.**, Division of General Cement Mfg. Co., 919 Taylor Ave., Rockford, Ill.

DUAL-RANGE D.C. POWER SUPPLY, *Electro Products model EF*, has continuously variable source for 0–14 and 0–28 volts for all loads 0–5 amperes, with a.c. ripple of less than 1% at 5 amperes. Intermittent loads to 10 amperes obtainable. Exact current and voltages indicated on D'Arsonval type



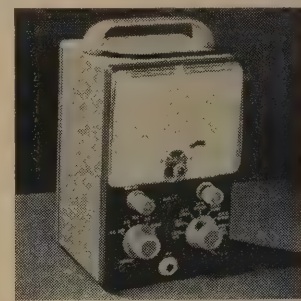
meters. Single control for continuous adjustments for different load conditions over specified range. Has 115-volt 50–60 cycle input, 265 watts at 28 volts, 5 amperes; choke input and pi type filters with 2 chokes and 2 2,000-μf capacitors; bridge type selenium rectifiers; heavy-duty control transformer for incremental voltage adjustment. *Model E* operates with less than 5% ripple at 5 amperes.—**Electro Products Laboratories, Inc.**, 4503 N. Ravenswood, Chicago 40, Ill.

FM RECEIVER KIT, *Approved V-9*, for an individual binaural or high-fidelity installation. Self-contained a.c. power sup-

ply; tuning range 88 to 108 mc; bandwidth 200 kc; two limiters and discriminator; sensitivity 10 μv, 20 db; tuned r.f. stage; 3-section variable capacitor.—**Approved Electronic Instrument Corp.**, 928 Broadway, New York 10, N. Y.

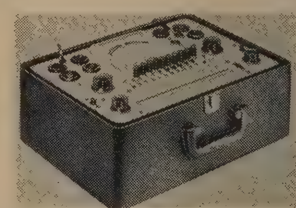
V.T.V.M. KIT, *Heath model V-7*, has printed-circuit board for reduced assembly time and constant circuit performance.

Has 7 a.c. (r.m.s.) and d.c. voltage ranges of 1.5, 5, 15, 50, 150, 500, 1,500; 7 peak-to-peak a.c. voltage ranges of 4, 14, 40, 140, 400, 1,400, 4,000; ohmmeter ranges of ×1, ×10, ×100,



×1,000, ×10,000, ×100,000, and ×1 megohm. Db scale provided, zero-center operation within range of front panel controls. 4½-inch meter, 1% precision resistors, a.c. power supply. Easily assembled in few hours. Peak-to-peak voltages read directly on meter face without calculation. Has 11-megohm input impedance.—**Heath Co.**, Benton Harbor, Mich.

TUBE TESTER KIT, *Knight*, measures tube performance by cathode-emission method. Checks for shorted elements, open elements, heater continuity. Tests 4-, 5-, 6- and 7-pin large, regular and miniature types; octals, loctals, 9-pin miniatures and pilot lamps. Has 4½-inch meter, line-voltage compensator, roll chart. Universal socket pin selectors permit testing, without wiring

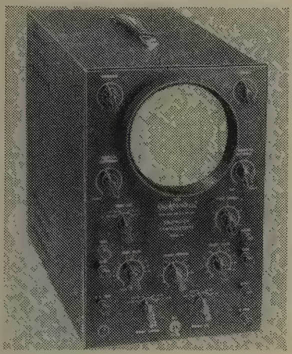


changes, tubes with new base arrangements. Roll chart removable for addition of new-tube testing data. Blank socket provided for future use. Single-unit 10-lever function switch simplifies assembly.—**Allied Radio Corp.**, 100 N. Western Ave., Chicago 80, Ill.

TV OSCILLOSCOPE, *National Radio Institute model 56*, for industrial applications where square-wave and pulse type signals must be observed.

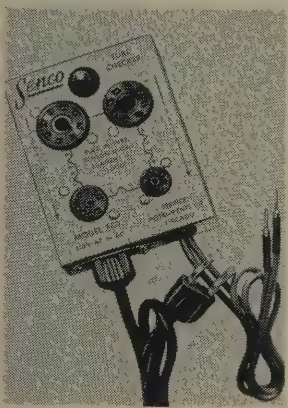
Vertical amplifier response flat from 10 cycles to 4.5 mc (±3 db). Four-step frequency-compensated vertical attenuator calibrated for direct peak-to-peak voltage measurement. Sensitivity .014 volt (r.m.s.) per inch of deflection. Linear sweep

range 10 cycles to 100 kc. Average vertical amplifier input impedance 2 megohms, and 25 $\mu\mu$f. Positive and negative sync,



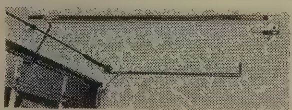
voltage-regulated power supply.—**National Radio Institute,** 16 & U Sts., Washington 9, D. C.

POCKET TUBE CHECKER, *Senco FC-3,* weighs less than 6 ounces. Checks filaments (or heaters) of all octal, loctal, 7- and 9-pin tubes, including all



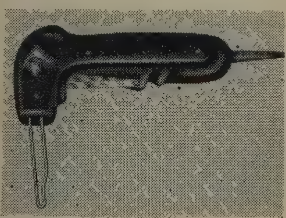
new 600-ma tubes used in series-filament TV sets.—**Service Instruments Co.,** 422 S. Dearborn St., Chicago 5, Ill.

GARAGE DOOR OPENERS, *Alliance Lift-A-Dor,* electrical and radio control. *Genie models KST-1,* key lock, straight track; *HST-1,* hydraulic straight track;



CT-1, curved track; *RCST-1,* radio-controlled straight track, and *A,* completely automatic radio-controlled, which opens and closes door, turns light on and off, locks and unlocks door, operates from car dash, and is set with individual transmitter.—**Alliance Mfg. Co.,** Alliance, Ohio.

SOLDERING IRON, *Esico Luger,* has lightweight Luger



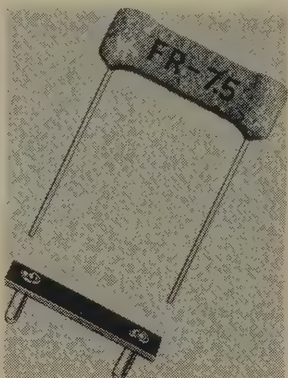
grip and fast-heating tip. Dual or single heat. Loop tip heats quickly, reaches hard-to-get-at places easily. Twin lights illuminate work, eliminate shadows. Rests on its side when not in use, needs no stand.—**Electric Soldering Iron Co.,** Deep River, Conn.

INSULATING LACQUER, *Insl-X A-11,* acts as binder for pie-wound coils; as sealant for plastic-molded units, oil-filled capacitors, and decals on phenolic surfaces, and as general-purpose high-quality adhesive. Supplied in colors and clear. Used for color-coding such units as ceramic capacitors subject to high operating temperatures. High dielectric strength and adhesion. Applied by brushing or dipping.—**Insl-X Sales Co.,** 26 Rittenhouse Place, Armore, Pa.

TVI FILTER, *Federal 3-Pi,* features new precision-engineered printed circuit designed to suppress interference from ignition systems, medical diathermy and X-ray equipment, neon

signs, amateur radio transmitters, electrical appliances. Transparent polystyrene plastic case 0–54-mc attenuation above 46 db.—**Federal Electronics,** Federal Electronics Bldg., Rockville Centre, N. Y.

FUSE RESISTOR, *Ohmite FR-7.5,* replaces any fuse resistor in TV receivers. 7½ ohms. Fur-



nished with 1½-inch tinned wire leads plus separate plug-in mounting strip. Can be soldered to strip for plug-in mounting or directly into circuit under chassis.—**Ohmite Mfg. Co.,** 3675 Howard St., Skokie, Ill.

HI-FI CABINETS. *REGENCY TM,* table model with precut, predrilled panels, can be used for Regency HF 80 or HF 150 amplifiers. Companion piece available for Regency tuners. *Model TMC* designed for HF 80 or HF 150 amplifier or AF 220 tuner, with any standard record

The Word We Dreaded

My husband and I were together when the phone rang. He got up to answer it and I held my breath as I heard his quiet, "Yes, Doctor?"

Then he put the receiver down carefully. His face, when he turned to me, was gaunt and lined, but he was trying to smile.

"Was it—the laboratory tests?" I asked.

He nodded. "We'd better get my bag packed," he said gently. "They want me in the hospital this evening."

We had realized for months that something was wrong. But the pressure of his business postponed action. "Guess I'm a little off my feed," was all he would say.

It took our family physician only ten minutes to change that attitude. He made an immediate appointment with a specialist. And at the end of an anguished week we knew. The laboratory tests confirmed the word we dreaded—"Cancer."

That was a year ago. Modern cancer research saved my husband. That... and the surgeon's skill, the strength of our faith and his own fighting heart. He is alive and well today. For us the story has had a happy ending.

Yet it *isn't* ended. When we think of the thousands of other families tragically broken every year, we feel we still have work to do. Many types of cancer *can be cured* if caught in time.

We tell our friends, "If there are symptoms you don't understand, see your doctor at once." And we *give* to support the constant research of the American Cancer Society in finding the causes and reducing the incidence of cancer.

American Cancer Society

GENTLEMEN:

I want to help conquer Cancer.

☐ Please send me free information about Cancer.

☐ Enclosed is my contribution of $_____ to the Cancer Crusade.

Name__________

Address__________

City________Zone____State_____

(MAIL TO: CANCER, c/o your town's Postmaster)

Strike back at CANCER... man's cruelest enemy... GIVE

changer. Optional wrought-iron legs for conversion to consolette model. *Model CTC* adaptable to any Regency amplifier or tuner, and any record changer. Re-

gency, Division of I.D.E.A. Inc., 7900 Pendleton Pike, Indianapolis 25, Ind.

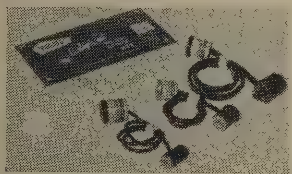
REPLACEMENT FLYBACKS, *Stancor A-8253, A-8254, A-8255,* replace Admiral parts 79D48-1,

97C60-1, 70C60-A, respectively. Exact electrical and physical duplicates of the units they replace.—**Chicago Standard Transformer Corp.,** Standard Division, Addison & Elston, Chicago 18, Ill.

MICROPHONE STAND, *Atlas Porta-Boom,* is collapsible to easily transportable size; quick to knock down and set up. Features piston air-check mechan-

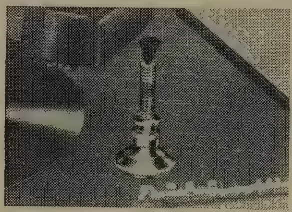
ism permitting rapid height adjustment without danger of sudden downward motion. Two-position dual control rotates mike through 360°; suspension is noisefree and positioning automatic at all boom angles.—**Atlas Sound Corp.,** 1451 39 St., Brooklyn, N. Y.

TUBE SOCKET ADAPTER KIT, *Vidaire AT-K,* contains three *Adap-Test* units: *AT-1* for all octal tubes; *AT-2* for 7-pin miniatures; *AT-3* for 9-pin miniatures. Test points numbered for identification. Extension



leads 20 inches long reach all tube sockets.—**Vidaire Electronics Mfg. Corp.,** 576 W. Merrick Rd., Lynbrook, N. Y.

AUTOMATIC CHANGER NEEDLE BRUSH. *Robins KLeeNeeDLE,* keeps needles clean, removes dust from under needle point, prevents it accumulating on needle and causing distortion and poor fidelity.



Dust is removed each time tone arm moves, wiping needle over *KLeeNeeDLE* brush. Height adjustable, fits most record changers. Fastened by pressure-sensitive adhesive supplied.—**Robins Industries Corp.,** 82-09 251 St., Bellerose 26, N. Y.

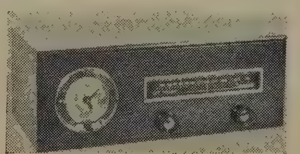
MIGHTY MIDGET INVERTERS, *ATR,* for portable use equipped with cigarette lighter cord sets. Use on 6- or 12-volt storage battery systems simply by plugging into cigarette lighter receptacle on dash. De-

liver 110 volts a.c., 60 cycles; output as high as 100 watts. Useful for operating dictating machines, small tape recorders, etc.—**American Television & Radio Co.,** 300 E. 4th St., St. Paul 1, Minn.

TV TUBE BRIGHTENER rejuvenates dim picture tubes. Operates on all types of pic-

ture tubes—magnetic or electrostatic—and in all circuits—parallel or series.—**Mail Mart,** Dept. RE, 526 S. State St., Springfield, Ill.

FM TUNER, *Browning Brownie model CL,* has GE Telechron clock-timer unit installed in a cabinet complete with 3-way a.c. outlet, making it possible to preset tuner to turn a complete high-fidelity system on or off automatically.—**Browning Laboratories, Inc.,** Winchester, Mass. END



All specifications given on these pages are from manufacturers' data.

new Tubes & Transistors

New projection tube

RCA has announced the 5AZP4, a television projection tube capable of providing auditorium-size 8 x 6-foot pictures. The tube uses electrostatic focus and magnetic deflection. This type focus simplifies the use of the tube with a reflective optical system. The 5AZP4 has a metal-backed white fluorescent screen.

Operating with a maximum second-anode voltage of 40,000 and a maximum focusing-electrode voltage of 8,600, the 5AZP4 features a molded-on second-anode connection cable 48 inches long; a bulb with insulating coating to minimize leakage over its external surface under conditions of high humidity; a gun structure using anti-corona thimbles to prevent internal arcover and stray emission; only one high-voltage envelope connection—other connections are made through a plastic-filled duodecal seven-pin base.

The projection tube is intended primarily for closed-circuit applications, such as demonstration, training and educational work by business organizations and schools.

2N104 junction transistor

A hermetically sealed germanium-alloy junction transistor, the 2N104, has been announced by RCA. The semiconductor is of the p-n-p type intended for low-power audio applications. It is ¼ inch in diameter and 11/16 inch in overall length.

The design of the 2N104 features a low base-lead resistance which minimizes ohmic losses, improves frequency response and provides high input-circuit efficiency. In a common-emitter circuit, it has a collector-to-base current amplification ratio of 44, a matched-impedance low-frequency power gain of 40 db and a collector-to-base alpha frequency cutoff of 13.9 kc. An unusually low noise factor of 12 db contributes to the dependable performance of this transistor in most low-level audio applications. The collector dissipation of the 2N104 is approximately 35 milliwatts.

5894

A small, sturdy, twin-beam power tube, the 5894, has been announced by RCA. It is intended primarily for use as a push-pull r.f. power amplifier or as a frequency tripler in fixed and mobile equipment operating in the u.h.f. range between 450 and 470 mc.

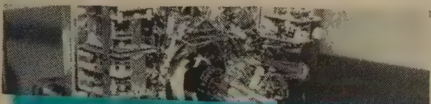
The 5894 has a maximum plate dissipation rating of 40 watts under CCS

conditions. In class-C telegraphy and frequency-modulated amplifier service at 470 mc, the tube can deliver a useful power of approximately 55 watts, measured at the output circuit load. As a tripler to 462 mc, it can deliver about 16 watts.

The high efficiency obtainable with the 5894 in conventional push-pull circuits, even at frequencies as high as 500 mc, is made possible by: the balanced, compact structure of the beam-power units which have low interelectrode capacitances; internal neutralization; close electrode spacing; a cathode common to the two units.

TV check tube

Sylvania has announced a new television receiver check tube (see photo), the 5AXP4. It is a 5-inch round, magnetically deflected tube using electrostatic self-focusing.



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4-55

only 10 watts drive ... 1,000. It features resonant cavities completed outside the vacuum system, free of r.f. circuitry. This permits wide-range tuning and simple input and output coupling. For those interested, the klystron sells for $4,200. END

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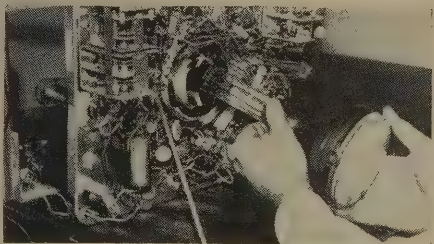


The 5AXP4, intended primarily for TV service technicians and equipment manufacturers, will permit a cabinet-mounted picture tube to be left in the cabinet while the receiver is being serviced in the shop. It is a universal type tube that can be inserted into almost any TV chassis while the set is being serviced (see photo).

The tube contains a built-in focus system and so does not require any focus device or ion-trap magnet while making tests on a receiver. The 5AXP4 is so light that the yoke of the receiver very easily supports the tube. The only electrical connections required are the high-voltage lead and the picture-tube socket of the receiver. The tube can be used in any receiver, regardless of the deflection angle.

10-kw klystron

One of the higher-priced tubes of the season, a new high-power u.h.f. amplifier klystron (see photo), the Eimac 3K50,000LQ, has been announced by Eitel-McCullough, San Bruno, Calif.

In CW operation at 850 to 1,050 mc, the tube delivers 10 kw output with

only 10 watts drive—a power gain of 1,000. It features resonant cavities completed outside the vacuum system, free of r.f. circuitry. This permits wide-range tuning and simple input and output coupling. For those interested, the klystron sells for $4,200. END

Technicians' News

N. Y. LECTURE SERIES

A lecture series for New York radio and TV technicians was scheduled for the late winter and spring by the Empire State Federation of Electronic Technicians Associations at their January meeting in Binghamton.

The initial lecture—on a transistor portable radio—was scheduled for New York City in February, to be given subsequently in the Buffalo–Western New York, Syracuse–Binghamton and Kingston areas. Succeeding lectures would follow the same route.

The Binghamton meeting also went on record as favoring action that would pave the way for unity on a national level among service organizations. To this end, and with the concurrence of Ferdinand J. Lynn of Buffalo, Eastern vice president of NATESA, and Max Liebowitz, president of NETSDA, who were present, it is urged by ESFETA that committees representing both groups as well as any other interested group meet in the near future to develop such unity.

A REAL SERVICE AID

A single sheet, containing on one side the schematic and on the other the tube placement diagram and most necessary service information, is inserted in the service data brochure on RCA's recent chassis KCS93 (models 17-S-450R, -451R and -453R). This "field service data sheet" is for the technician's convenience on home calls, giving him the information he is likely to need without the necessity of handling a multipage service data folder, as well as permitting the folder to remain in the shop for bench use.

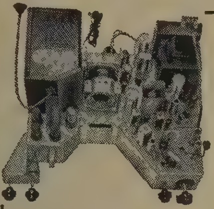
This is a real step forward in the dispensing of service information.

YOU CAN SERVICE RADIO!

The story of the little girl who asked her teacher: "What's a radio?" is paralleled in dead seriousness by the Associated Radio-Television Service Dealers News of Columbus, Ohio. In a short paragraph recommending a recent book on radio receiver servicing it says, "Many of our members in their enthusiasm for TV are overlooking this source of income. If you can service TV, you can service a radio. This book will greatly help you understand just what goes on in a radio."

Maybe RETMA can be prevailed on to organize courses in radio servicing for TV technicians?

THE #630 TV RECEIVER remains unmatched for quality and performance • • • RCA designed and developed this set quality-wise *not* price-wise • • • The original 10" set retailed at $375.00 • • • Subsequent TV sets serve to prove the sacrifice of quality for price • • • what better proof can there be of its superiority than the fact that it is the choice of TV engineers and TV technicians! Herewith we offer you—YOUR BEST BUYS IN TV!—All you pay is the price shown • • • Excise taxes have already been paid by us.



Build your own

SUPER DE LUXE 31-TUBE #630 TV CHASSIS

#630 SUPER DE LUXE 31-TUBE TV KIT

Engineered in strict adherence to the genuine RCA #630 plus added features • • • OPERATES 16" to 24" PICTURE TUBES • • • CASCODE TUNER • • • COSINE YOKE • • • LARGER POWER TRANSFORMER • • • KEYED AGC • • • 12" SPEAKER • • • CONDENSERS and RESISTORS at rated capacities and tolerances. You receive a COMPLETE SET OF PARTS AND TUBES. Everything needed is included, (less CRT and wire.) You will enjoy building it with "LIFE-SIZE easy to follow step-by-step ASSEMBLING INSTRUCTIONS" included with each KIT.

slashed to **$99.99**

#630 SUPER DE LUXE TV CHASSIS

LICENSED UNDER RCA PATENTS

COMPLETE READY TO PLUG IN AND PLAY— Similar in characteristics and features to the TV KIT above • Manufactured especially for us by nationally known manufacturers • No efforts or expense have been spared in workmanship or materials, to make this #630 SUPER DE LUXE TV CHASSIS the Best obtainable for fringe areas, clarity and all-around-performance. Customers report reception better than 200 miles. Each set is factory aligned and air-tested • All parts carry the RMA three month guarantee • Our mass volume of business on this CHASSIS (numbering thousands of pleased customers) now makes it possible for us to reduce the price, (less CRT.)

slashed to **$142.27**

We Also Sell The Complete Line of **TECH-MASTER** #630 TV CHASSIS. Catalog mailed on request.

Modernize a #630 or any TV Set with a STANDARD CASCODE TUNER

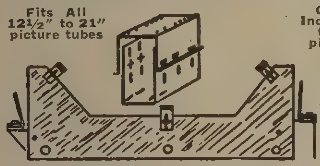
For better all around performance

Complete with tubes and Brooks CASCODE MANUAL with step-by-step instructions and all extra parts needed. **$17.97**

UNIVERSAL Picture Tube MOUNTING BRACKETS

Fits All 12½" to 21" picture tubes

Complete — Including band that holds picture tube



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Finest, most accurate and the easiest Kit to install in a #630 or in any other make TV receiver. Improves performance, and insures a steady picture on all channels.

COMPLETE SET OF PARTS Including 6AU6 tube & Instructions **$2.99**

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SELENIUM RECTIFIER 100ma	.69
SELENIUM RECTIFIER 150ma	.74
SELENIUM RECTIFIER 300ma	1.28
SELENIUM RECTIFIER 500ma	1.78
AUDIO OUTPUT TRANSFORMER (50L6)	.29
AUDIO OUTPUT TRANSFORMER (6K6)	.49
PHONO MOTOR 3 speed, complete with t.t.	4.19
PHONO AMPLIFIER, incl. 3 tubes	4.68
TV POWER TRANSFORMER, 250ma	3.98
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TV BACK CUP, for recessing CRT	.29
RCA FLYBACK TRANSFORMER, doubler type	1.17
GEN. ELECTRIC AGC WIDTH COIL	.19
TV 90° DEFLECTION YOKE	5.98
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REGENCY $49.95 UHF CONVERTER, Comp.	19.97
#630 CHASSIS PAN, with sockets on	5.94

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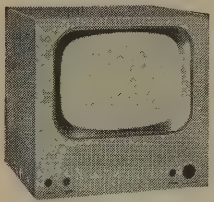
From Factory to You

4 LEADING STYLES in genuine mahogany or walnut (blond 10% extra) • Ready drilled for any # 630 TV chassis and cutout for any 16", 17", 19", 20" or 21" picture tube at no extras in price • Also supplied with undrilled knob panel for any other TV set • EVERYTHING NECESSARY for an easy perfect chassis and CRT assembly is included • Each cabinet is delivered complete as pictured with mask, safety glass, mounting brackets, backboard, backcup, hardware and assembling instructions • Each cabinet is shipped in an air cushioned carton from FACTORY to YOU!

The VOGUE



H-25", W-26", D-22"

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H-37", W-28", D-24¼"

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#630 Parts in COMPLETE SETS

TV WIRE & SOLDER KIT, for any Set	$ .98
630-KIT, screws, nuts, rivets, washers, etc.	1.69
TERMINAL STRIP KIT, set of 30	.69
VIDEO AND I.F. KIT, 19 items	4.99
VARIABLE CONTROL KIT, 9 controls	3.97
CARBON RESISTOR KIT, 107 resistors	4.98
WIREWOUND RESISTOR KIT, 4 resistors	1.76
BRACKET AND SHIELD KIT, 18 items	6.44
ELECTROLYTIC CONDENSER KIT, 6 cond.	4.96
TUBULAR CONDENSER KIT, 38 condensers	3.63
CERAMIC CONDENSER KIT, 28 condensers	1.98
MICA CONDENSER KIT, 11 condensers	.97
COMPLETE SOCKET KIT, 25 sockets	1.57
COMPLETE SET OF TUBES, 29 tubes	24.64

PARTS For #630 TV SETS

PUNCHED CHASSIS PAN, cadmium plated		$3.96
COMPLETE SET OF KNOBS, incl. decals		.99
POWER TRANSFORMER, 295ma.	201T6	9.16
VERTICAL OUTPUT TRANS.	204T2	2.24
VERTICAL BLOCKING TRANS.	208T2	.98
HORIZONTAL OUTPUT TRANS.	211T1	1.62
HORIZONTAL OUTPUT TRANS.	211T5	2.97
FOCUS COIL, 247 ohms,	202D1	1.64
FOCUS COIL, 470 ohms,	202D2	2.93
DEFLECTION YOKE, 60°	201D1	1.14
DEFLECTION YOKE, Cosine 70°	206D1	3.45
SOUND DISCRIMINATOR TRANS.	203K1	.94
1st PIX I.F. TRANSFORMER,	202K2	.88
2nd PIX I.F. TRANSFORMER,	202K3	.88
1st or 2nd SOUND I.F. TRANS.	201K1	.69
HORIZONTAL DISCRIM. TRANS.	208T8	.98
FILTER CHOKE, 62 ohms		1.15
CATHODE TRAP COIL,	202K4	.88
WIDTH CONTROL COIL, keyed AGC		.52
ION TRAP BEAM BENDER, single	203D1	.52
HV RECTIFIER, SOCKET ASSEMBLY, double		.98

H. V. FILTER CONDENSERS—(Cartwheels)

10kv	500 mmf	.10
20kv	500 mmf	.39
30kv	500 mmf	.97

Brooks LIFE-SIZE TV INSTRUCTIONS for building any #630 TV Receiver ..... **$1.25** Postpaid

HINTS FOR BETTER PERFORMANCE on your #630 TV receiver ..... **50c** Postpaid

Brooks CASCODE MANUAL, how to install Cascode Tuner in any make TV Set. ..... **25c** Postpaid

100 ASSORTED TUBULAR **CONDENSERS**

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15 —	Assorted TV Electrolytic CONDENSERS	$4.97
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100—	ASSORTED CERAMIC CONDENSERS	$3.72
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100—	ASSORTED SOCKETS Octal, Loctal & Miniature	$2.79
100—	ASSORTED KNOBS SCREW & PUSH-ON	$2.84
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GUILD MEETS THE D.A.

Officers of the Radio and Television Guild of Long Island met with the local District Attorney, Frank Gulotta, to discuss ways and means of curbing unethical and fraudulent practices in TV servicing. The meeting was the result of newspaper reports that the D. A. was requesting "laws to curb TV gyps."

Mr. Gulotta was especially interested in the Guild's grievance committee, set up to receive complaints against service technicians and to act on them. After the discussion, he agreed to refer to the Guild complaints received at his office, whether the complaint is against a Guild member or not. Results of the grievance committee's investigation are to be turned over to the District Attorney's office.

The Guild members pointed out that most complaints have resulted from misunderstanding between customer and technician and that the best way to improve customer relations is to clear up these situations before they get out of hand.

PHILADELPHIA UNITES

Delegates from the Northeast T.S.D.A., Television Contractors Association and Television Service Dealers Association of Philadelphia met February 10 to iron out final points of amalgamation as authorized by their membership. Upon reaching satisfactory agreement the delegates voted for the formation of a consolidated group to be known as the Electronic Service Association. This, it was stated, would bring all the Philadelphia service dealer groups under one banner, making it the largest service dealers' association.

Temporary officers were appointed to hold office till an official election is held by the entire membership. The appointed officers are Fred Weissman, chairman; Albert Haas, vice chairman and treasurer; Wm. Weil, Jr., secretary, and Dave Krantz, corresponding secretary and chairman of publicity.

Messrs. Richard Devaney and Samuel Brenner of the Philadelphia Radio Service Men's Association were present at the meeting and reported that their board of directors had voted in favor of consolidating with the newly formed E.S.A. and were now awaiting the approval of the membership. The P.R.S.M.A. is one of the largest and oldest technicians' organizations.

A committee under the chairmanship of Dave Krantz will study the individual constitutions and by-laws of each of the uniting groups for the purpose of preparing a set of operating rules for the E.S.A.

RETMA TRAINING COURSES

The Radio-Electronic-Television Manufacturers Association has issued a booklet, *Industry Advisory Groups*, explaining in detail the organization of committees to coordinate local interests and to establish in their localities courses based on the methods, curricula,

manuals of instruction, special equipment for training and teaching methods developed under the supervision of the RETMA Service Committee.

The 14-page booklet is available to all service groups, educators and other interested parties upon request from RETMA headquarters, 777 14 St. N. W., Washington, D. C.

LONG BEACH ASKS LICENSE

The Long Beach, Calif., Radio Technicians Association has proposed to its City Council that an ordinance be established requiring that all radio-TV technicians be licensed. RTA proposes that a board of examiners be set up to pass on the fitness of service technicians before issuing them licenses permitting them to service radio and television equipment in Long Beach.

MORE TV ANTENNA USES

An item in this column last month told how a Nebraska family used their TV antenna mast as a fire escape. Harry Josephs, a Pennsylvania service technician, sends us the following:

One of our customers has a duck blind at a lake near his home. When rival hunters claimed last fall that their blinds had hot and cold running water and all the comforts of home, this customer hauled us all the way out to his blind and had us stick up a complete antenna system—*without* a TV set. "It's just a gag," he explained, "and if it scares the ducks, we'll pay you to take it down." He and his friends spread the word to other hunters that their video set is battery-powered and they watch TV when the ducks aren't flying! When rival hunters get too curious and come over to see for themselves, the "missing" set is always "in Josephs' shop getting repaired."

INDISCRIMINATE SELLING

The following resolution was released by the Associated Radio and Television Servicemen, Ill., a Chicago association:

"The individual members of ARTS, Illinois, independent radio and television service shop owners and dealers, have long known of and suffered from the practice of indiscriminate selling at wholesale prices to any and all of the consuming public by the radio and electronics parts jobbers and wholesalers.

"They are also aware of the indiscriminate distribution by these same jobbers and wholesalers of catalogs containing wholesale prices of electronic parts and supplies.

"Therefore the members of ARTS, Illinois, express themselves in opposition to these unfair trade practices.

"Further, the members of ARTS, Illinois, request their officers and executive committee to make known the feeling and the position of the members regarding this sales policy." END

Measures 6¼" x 9½" x 4½"

Superior's new Model 670-A

SUPER METER

A COMBINATION VOLT-OHM MILLIAMMETER PLUS CAPACITY REACTANCE INDUCTANCE AND DECIBEL MEASUREMENTS

SPECIFICATIONS:

D.C. VOLTS: 0 to 7.5/15/75/150/750/1,500/7,500 Volts
A.C. VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
OUTPUT VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5/15 Amperes
RESISTANCE: 0 to 1,000/100,000 Ohms 0 to 10 Megohms
CAPACITY: .001 to 1 Mfd. 1 to 50 Mfd. (Good-Bad scale for checking quality of electrolytic condensers.)
REACTANCE: 50 to 2,500 Ohms 2,500 Ohms to 2.5 Megohms
INDUCTANCE: .15 to 7 Henries 7 to 7,000 Henries
DECIBELS: −6 to +18 +14 to +38 +34 to +58

ADDED FEATURE:

Built-in ISOLATION TRANSFORMER reduces possibility of burning out meter through misuse.

The Model 670-A comes housed, in a rugged crackle-finished steel cabinet complete with test leads and operating instructions.

$28.40 NET

Superior's new Model TV-11

TUBE TESTER

SPECIFICATIONS:

★ Tests all tubes including 4, 5, 6, 7, Octal, Lock-in, Peanut, Bantam, Hearing Aid, Thyratron Miniatures, Sub-miniatures, Novals, Sub-minars, Proximity fuse types, etc.

★ Uses the new self-cleaning Lever Action Switches for individual element testing. Because *all elements are numbered according to pin-number in the RMA base numbering system*, the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TV-11 as any of the pins may be placed in the neutral position when necessary.

★ The Model TV-11 does not use any combination type sockets. Instead individual sockets are used for each type of tube. Thus *it is impossible to damage a tube by inserting it in the wrong socket.*

★ Free-moving built-in roll chart provides complete data for all tubes.

★ Newly designed Line Voltage Control compensates for variation of any Line Voltage between 105 Volts and 130 Volts.

★ NOISE TEST: Phono-jack on front panel for plugging in either phones or external amplifier will detect microphonic tubes or noise due to faulty elements and loose internal connections.

The model TV-11 operates on 105-130 Volt 60 Cycles A.C. Comes housed in a beautiful hand-rubbed oak cabinet complete with portable cover

EXTRA SERVICE — The Model TV-11 may be used as an extremely sensitive Condenser Leakage Checker. A relaxation type oscillator incorporated in this model will detect leakages even when the frequency is one per minute.

$47.50 NET

SUPERIOR'S NEW MODEL TV-40

C.R.T. TUBE TESTER

★ A complete picture tube tester for little more than the price of a "make-shift" adapter!!

The Model TV-40 is absolutely complete! Self-contained, including built-in power supply, it tests picture tubes in the only practical way to efficiently test such tubes; that is by the use of a separate instrument which is designed exclusively to test the ever increasing number of picture tubes!

EASY TO USE:

Simply insert line cord into any 110 volt A.C. outlet, then attach tester socket to tube base *(Ion Trap Need Not Be on Tube)*. Throw switch up for quality test . . . read direct on Good-Bad scale. Throw switch down for all leakage tests.

★ Tests *all* magnetically deflected tubes . . . in the set . . . out of the set . . . in the carton!!

SPECIFICATIONS:

- Tests ALL magnetically deflected picture tubes from 7 inch to 30 inch types.
- Tests for quality by the well established emission method. All readings on "Good-Bad" scale.
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- Tests for open elements.

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- ✓ *Audio Frequency Generator*
- ✓ *Bar Generator*
- ✓ *Cross Hatch Generator*
- ✓ *Color Dot Pattern Generator*
- ✓ *Marker Generator*

SPECIFICATIONS:

R. F. SIGNAL GENERATOR:

The Model TV-50 Genometer provides *complete* coverage for A.M. and F.M. alignment. Generates Radio Frequencies from 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 180 Megacycles on powerful harmonics. Accuracy and stability are assured by use of permeability trimmed Hi-Q coils. R.F. is available *separately,* modulated by the fixed *400 cycle sine-wave* audio or modulated by the *variable* 300 cycle to 20,000 cycle variable audio. Provision has also been made for injection of any external modulating source.

VARIABLE AUDIO FREQUENCY GENERATOR:

In addition to a fixed 400 cycle sine-wave audio, the Model TV-50 Genometer provides a variable 300 cycle to 20,000 cycle peaked wave audio signal. This service is used for checking distortion in amplifiers, measuring amplifier gain, trouble shooting hearing aids, etc.

BAR GENERATOR:

This feature of the Model TV-50 Genometer will permit you to throw an actual Bar Pattern on any TV Receiver Screen. Pattern will consist of 4 to 16 horizontal bars or 7 to 20 vertical bars. A Bar Generator is acknowledged to provide the quickest and most efficient way of adjusting TV linearity controls. The Model TV-50 employs a recently improved Bar Generator circuit which assures stable never-shifting vertical and horizontal bars.

CROSS HATCH GENERATOR:

The Model TV-50 Genometer will project a cross-hatch pattern on any TV picture tube. The pattern will consist of non-shifting, horizontal and vertical lines *interlaced* to provide a stable cross-hatch effect. This service is used primarily for correct ion trap positioning and for adjustment of linearity.

DOT PATTERN GENERATOR *(For Color TV)*

Although you will be able to use most of your regular standard equipment for servicing Color TV, the one addition which is a "must" is a Dot Pattern Generator. The Dot Pattern projected on any color TV Receiver tube by the Model TV-50 will enable you to adjust for *proper color convergence.* When all controls and circuits are in proper alignment, the resulting pattern will consist of a sharp white dot pattern on a black background. One or more circuit or control deviations will result in a dot pattern out of convergence, with the blue, red and green dots in overlapping dot patterns.

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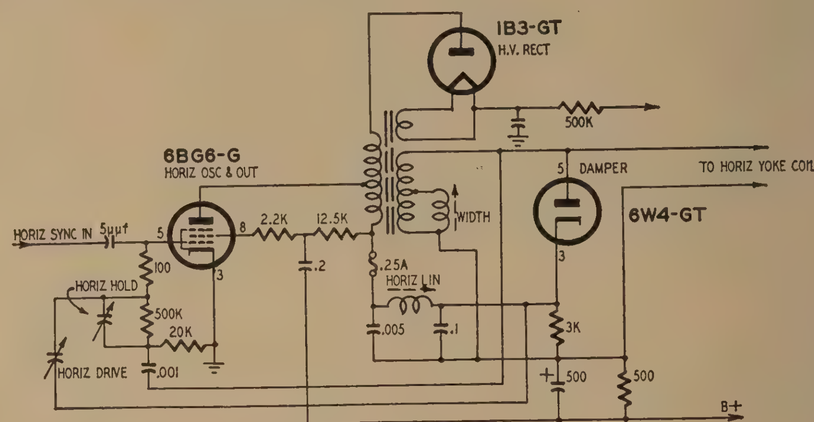
Technotes

MUNTZ MODEL 169 TV SET

This set came in with the picture shrunken to about 3 inches wide. The 6BG6-G horizontal oscillator and output tube was O.K. The trouble was traced to a leaky 0.2-μf capacitor in the screen-grid circuit of the 6BG6-G. The trouble cleared up when this defective capacitor was replaced with a good one having the same capacitance.—*Carl Hennig*



6W4-GT BURNOUTS?

Like H. A. Highstone (Tube Failures, page 186, January, 1954), I find burned out 6W4-GT's extremely rare. I've found only one genuine burnout among the many 6W4's I've repaired (I crimp the heater pins with diagonal cutters).

The tube base is a poor heat radiator so the solder softens in the heater pins and the lead opens. One failure cured me of attempting to resolder the pins. I now use the diagonal cutters to crimp the heater pins on all 6W4's suspected of cold-soldered joints and thus avoid a great deal of trouble.—*Walter T. Stevenson*

DUMONT RA-103-D

When the volume control was advanced beyond a certain critical point, a steady howl came from the speaker and black sound bars appeared on the screen. This was the tip-off that the howl originated at some point common to both picture and audio circuits. Tapping one of the 5U4G's gave an indication of the fault; replacing this defective tube cleared up the trouble immediately.

Upon examination, the filament of the tube showed flaking, which had apparently so weakened the tube that it vibrated with increased volume. On the other hand, there is the possibility that the vibration caused the flaking. —*H. L. Matsinger*

B PLUS SHORT IN RCA 6T54

Low sound volume and poor picture quality—several of these models had the same difficulty. When the tuner operating voltages were checked, only 40 volts was read at the 6AG5 r.f. amplifier test point. Normally there should be 115 volts here. Somehow or other this test-point terminal shorts to the tuner chassis, resulting in little or no B plus voltage at the 6AG5. The metal construction of the test-point terminal and the way it is mounted in the tuner chassis prevent its immediate replacement. To restore the receiver to normal operation I usually drill a 3/16-inch or smaller hole through the test-point terminal into the tuner and insert a piece of heavy wire enclosed in some spaghetti.—*Wilbur J. Hantz*

MOTOROLA VT 71M-A

A heater-to-cathode short in the third i.f. tube will show up as audio hum and the picture will have the usual black bars separated by a wide, rough white line, indicative of a.c. hum. An electrolytic capacitor will apparently have gone, but there will be no hum in the speaker when the volume control is turned two-thirds of the way down. Also the raster will be clean if you ground the control grid of the video output tube.—*B. W. Welz* END

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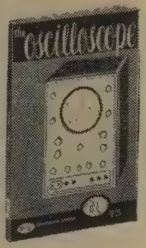

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OUTPUT TRANSFORMER—P.P. 6V6 to 3.2 Voice Coil 59c
OUTPUT TRANSFORMER—50 L6 to 3.2 Voice Coil 35c
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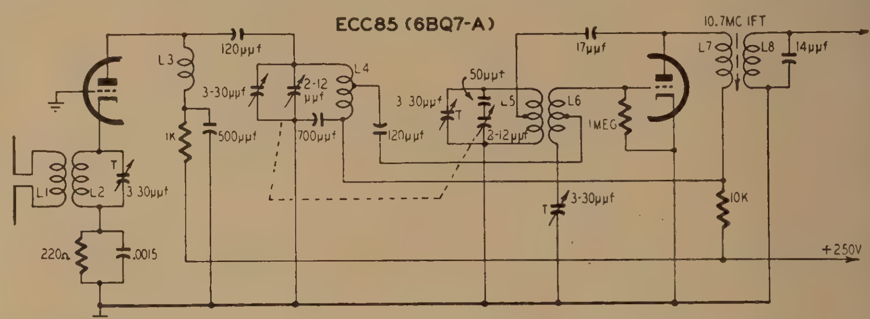
1-TUBE FM TUNER

A well-designed FM receiver should have a low-noise tuner with an r.f. stage to minimize oscillator radiation. Designers of high-quality tuners and receivers will frequently use two tubes in the front end while 3-tube circuits are found in some equipment. The r.f. amplifier is usually a pentode such as the 6BJ6.



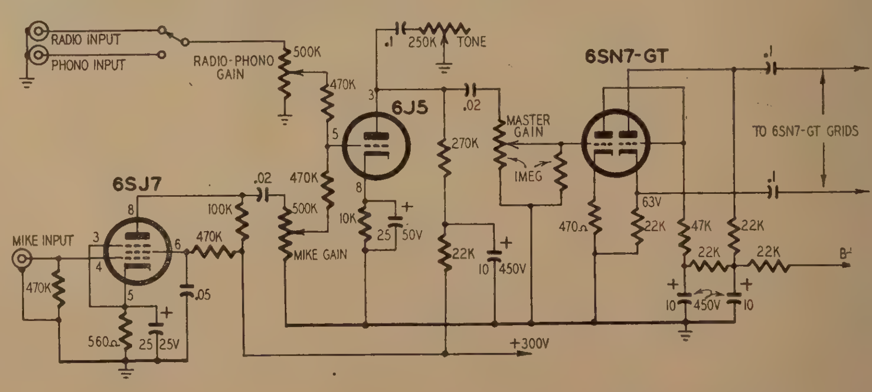
The diagram shows the circuit of a 1-tube FM tuner that appeared in the application notes on the Mullard ECC85—a British twin triode similar to the 6BQ7 and other tubes used in cascode and low-noise circuits. Its characteristics being similar to the 6BQ7-A, it is possible that the latter can be substituted without modifying the circuit.

In this circuit, one triode is a grounded-grid r.f. amplifier. This simplifies the circuit by eliminating the neutralization required with grounded-cathode triode r.f. amplifiers. Maximum gain is seldom required from an amplifier in a circuit such as this—its principal function is to isolate the antenna from the oscillator—so input coils L1-L2 can be adjusted for minimum noise rather than maximum voltage transfer. Use a noise generator to obtain optimum adjustment.

The second triode is a self-oscillating mixer. R.f. voltage is tapped off L4 and fed to the null point on oscillator coil L6 to minimize oscillator radiation and noise. The oscillator circuit is plate-tuned with L5 coupled to the plate through a 17-μμf capacitor. This capacitor also tunes the plate winding of the 10.7-mc i.f. transformer. The grid-plate capacitance of the mixer triode may reduce amplification so some i.f. voltage is tapped off the plate circuit and fed back into the grid circuit at the grounded end of L4.

PREAMP MIXER

Because I use my Williamson-type amplifier for occasional PA jobs, I added a built-in preamplifier and mixer for microphones and phonograph inputs. The diagram shows the preamp mixer and the input stage of the Williamson amplifier. Mixing takes place in the grid circuit of the 6J5 phono preamplifier. The 470,000-ohm series resistors in the grid leads prevent interaction between the gain controls. The 6SJ7 delivers enough gain for most high-impedance microphones. Low-impedance microphones of 50 to 600 ohms are used with mike-to-high-impedance adaptors.—*Pedro A. Loorluis*



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0D3/VR150	.85	2A7	.60	6B8G	.29	6SC7	.75	7Q7	.57	12SL7GT	.49	43	.53
0Z4	.59	2B7	.62	6BA6	.38	6SD7GT	.38	7R7	.59	12SN7GT	.50	45Z3	.40
1A4P	.35	2X2	.39	6BA7	.55	6SF5GT	.45	7S7	.83	12SQ7GT	.53	46	.45
1A5GT	.40	2X2A	1.14	6BC5	.49	6SF7	.58	7V7	.87	12SR7	.49	47	.85
1A7GT	.45	3A4	.44	6BE6	.37	6SG7	.40	7W7	.85	12Z3	.39	49	.38
1AB5	.38	3A5	.90	6BF5	.69	6SH7	.60	7X6	.57	14A4	.65	50L6GT	.61
1B3GT	.67	3A8GT	.59	6BG6G	1.15	6SH7GT	.50	7Y4	.40	14A5	.57	50X6	.62
1C5GT	.40	3B7	.39	6BH6	.45	6SJ7	.54	7Z4	.45	14A7	.53	50Y6GT	.57
1C7G	.37	3D6	.38	6BJ6	.41	6SK7	.39	12A6	.49	14AF7	.59	56	.47
1D7GT	.75	3LF4	.71	6BK7	.89	6SL7GT	.49	12A7	.98	14B6	.45	57	.53
1E7GT	.35	3Q4	.48	6BL7GT	.65	6SN7GT	.48	12AH7GT	.85	14B8	.63	58	.56
1F4	.40	3Q5GT	.63	6BN6	.89	6SQ7	.49	12AL5	.40	14C5	.80	70L7GT	1.00
1F5G	.44	3S4	.46	6BQ6GT	.75	6SR7	.45	12AT6	.35	14C7	.65	71A	.52
1H4G	.40	3V4	.50	6BQ7	.88	6ST7	.48	12AT7	.62	14E6	.65	76	.42
1H5GT	.38	5T4	1.25	6C4	.35	6T8	.57	12AU6	.36	14E7	.80	77	.53
1J6G	.59	5U4G	.49	6C5	.39	6U7G	.45	12AU7	.59	14F7	.65	78	.43
1L4	.45	5V4G	.76	6C6	.54	6U8	.59	12AV6	.44	14FH	.90	81	1.10
1L6	.61	5Y3G	.38	6C8G	.85	6V6	.48	12AV7	.64	14H7	.57	82	.67
1LA4	.59	5Z3	.33	6CB6	.42	6W4GT	.41	12AX4GT	.55	14N7	.67	83	.77
1LA6	.75	6A6	.45	6CD6G	1.05	6W6GT	.41	12AX7	.55	14Y4	.67	84	.52
1LB4	.77	6A7	.80	6D6	.67	6X4	.35	12AY7	.72	19	.45	85	.57
1LC5	.59	6A8	.65	6D8G	.95	6X5	.35	12BA6	.47	19BG6G	1.15	89Y	.29
1LC6	.75	6AB4	.42	6E5	.76	6X8	.70	12BA7	.59	19T8	.75	117L7GT	1.17
1LD5	.49	6AB7	.71	6F6	.45	7A4	.45	12BD6	.46	22	.40	117Z3	.38
1LE3	.75	6AC5GT	.95	6F7	.90	7A5	.55	12BE6	.45	25AV5GT	.80	117Z4GT	.73
1LG5	.75	6AC7	.68	6F8G	.69	7A6	.65	12BH7	.65	25BO5GT	.75	117Z6GT	.70
1LH4	.75	6AF4	.89	6G6G	.63	7A7	.65	12C8	.34	25L6GT	.40	2051	.93
1LN5	.55	6AF6G	.75	6H6	.49	7AD7	.90	12F5GT	.35	25W4GT	.45	803	2.95
1N5GT	.61	6AG5	.47	6J5	.38	7AG7	.55	12H6	.45	25Z5	.60	807	1.45
1P5GT	.56	6AG7	.90	6J6	.50	7AH7	.55	12J5GT	.39	25Z6GT	.45	814	3.50
1Q5GT	.55	6AH6	.98	6J7	.49	7B4	.44	12J7GT	.57	26	.42	832A	5.95
1R4	.81	6AK5	.59	6J8G	.90	7B5	.55	12K7	.53	27	.37	866A	1.45
1R5	.47	6AL5	.35	6K6GT	.39	7B6	.55	12K8	.55	32L7GT	.95		
1S4	.55	6AQ5	.39	6K7G	.38	7C4	.55	12Q7G	.57	35C5	.37		
1S5	.40	6AQ6	.36	6K8G	.64	7C7	.65	12S8GT	.60	35L6GT	.45		
1SA6	.48	6AQ7GT	.68	6L6G	.99	7E5	.59	12SA7GT	.62	35W4	.59		
1T4	.46	6AS5	.62	6L6GA	.99	7E6	.40	12SC7	.68	35Y4	.44		

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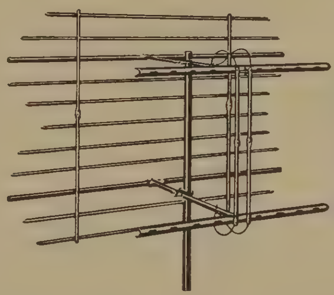

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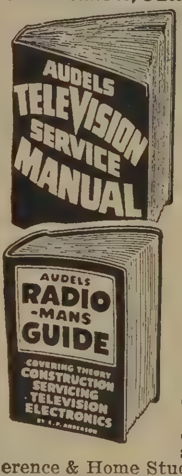

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INTERVAL TIMER

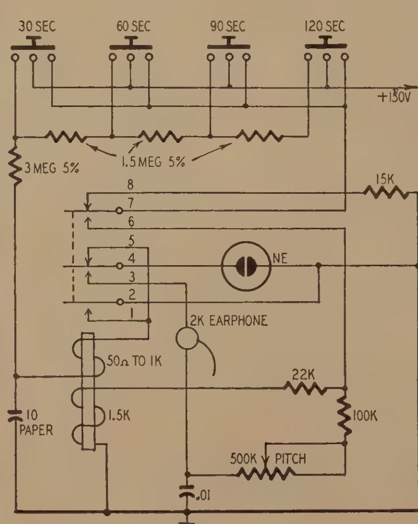
Most electronic timers for photographic operations and other applications use R-C time constants to control the flow of current in a vacuum tube or thyratron. A novel device using a neon tube in the timing circuit was developed to give an audible indication at the end of a 30-, 60-, 90- or 120-second preset interval. This instrument, designed for timing the steps in operating a machine for cleaning watch parts, is described in *Wireless World*. It operates by push buttons and is readily adaptable to such photographic operations as printing, developing, washing and fixing. The circuit is shown.

Operation is as follows: Assume that the 30-second button is pressed. The 10-μf capacitor begins to charge through the 3-megohm resistor. When the capacitor voltage rises to the striking voltage of the neon lamp, it conducts and current flows through the 50-ohm coil and operates the relay.

Contacts 1 and 2 are adjusted so they close and short-circuit the neon lamp before the other contacts operate. The remaining charge on the 10-μf capacitor flows through the 50-ohm coil to fully actuate the relay. Contacts 7-8 open and 7-6 close to excite the 1,500-ohm relay coil through the 22,000-ohm resistor. Contact 4 swings from 5 to 3, thus converting the neon lamp from a timing element to a relaxation type audio oscillator to produce a tone in the earphone. The tone continues until one of the remaining push buttons is pushed to release the first one pressed. This removes excitation from the 1,500-ohm coil and resets the instrument for the next timed interval.

If you want the device to operate an external circuit, disconnect the leads from contacts 3, 4 and 5; remove the earphone, .01-μf capacitor and the 100,000- and 500,000-ohm resistors, and use contacts 3, 4 and 5 for the external circuit.

The four push buttons are double-pole mechanically interlocked units like those used in some intercoms, tube testers and broadcast receivers. The relay is a double-coil type. The resist-

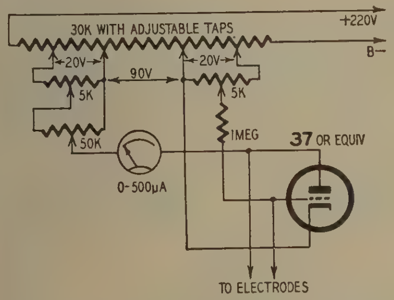


ance of the "operate" coil may be any convenient value between 50 and 1,000 ohms. The "hold" coil resistance may differ greatly from that shown. The series and hold-coil resistances may be adjusted so the circuit passes just enough current to hold the armature after it has been pulled in by the operate coil.

Timing can be adjusted by raising the B supply voltage or by inserting a series resistance in the B supply line. The value of the 15,000-ohm resistor from contact 8 to ground is adjusted so it passes the same amount of current as is drawn by the hold and tone-generating circuits combined. Adjust the value of this resistor accordingly when using an external tone or alarm circuit.

MOISTURE METER

There are a number of different types of instruments for measuring the moisture content of various solids and gasses. This simple moisture meter, described in *Electronic Engineering* (London, England), may be used to indicate, compare or measure the moisture content of wood, textiles, ceramics, paper, dry foods and other materials.



The triode is supplied with operating voltages from taps on a 30,000-ohm voltage divider. The indicating meter is in the plate circuit. The electrodes or test prods to be pressed against the material under test are connected to grid and plate. Since the resistance or conductance of an insulator or near-insulator varies with the amount of moisture, this resistance affects the meter reading when connected between grid and plate.

The initial reading is determined by the pressure of the electrodes against the sample so pressure should be raised until the meter reading becomes fairly stable.

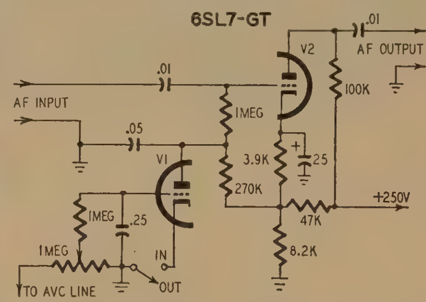
The three potentiometers are for meter adjustment and calibration. Sensitivity can be increased by using a more sensitive meter or by increasing the spacing between electrodes. Decrease sensitivity by lowering the value of the grid resistance.

AUDIO SQUELCH

Audio squelch circuits vary greatly in design but nearly all of them are controlled by the a.v.c. voltage. Some use a d.c. amplifier or control tube to close a relay and open or short one of the a.f. grid, plate or voice coil leads

to silence the receiver in the absence of a signal of predetermined strength. This circuit, reprinted from *La Radio-Revue* (Antwerp, Belgium), is similar to the circuit on page 110 of the April 1954 issue in that it also uses a d.c. bias from the grid of an audio voltage amplifier.

V2 is the a.f. amplifier and V1 the control tube operating from the a.v.c. line. When the switch is closed and there is no signal coming in, V1 con-



ducts to develop a voltage drop across the 270,000-ohm resistor and drive V2 to cutoff. When a signal is tuned in, the a.v.c. voltage rises sufficiently to cut off V1. This removes the voltage drop across the 270,000-ohm resistor and restores normal bias to V2 so it conducts and amplifies normally. The 1-megohm control in V1's grid circuit controls the sensitivity of the squelch circuit.

This type audio squelch circuit can be used in most communication receivers and is particularly useful where the receiver has to be kept on for long periods of time while no signals are being received. In noisy areas this circuit becomes one of the more important circuits in a receiver. END

CORRECTIONS

There is an error in the wiring of the bandswitch section in the plate circuit of the 6BE6 mixer in the all-wave tuner on page 168 of the January issue. This section of the switch should be wired so the primary of the 1500-kc i.f. transformer is shorted when tuning bands A and B and the primary of the 456-kc first i.f. transformer is shorted when tuning bands C and E.

We thank Robert E. Flanagan of Dorchester, Mass., for this correction.

Another error appears in Fig. 2 of the article "Gilding the Golden Ears" in the February issue. The 100,000-ohm grid-return resistors for the 1614's were inadvertently omitted from the diagram. These resistors connect from the left-hand ends of the 1,200-ohm series grid resistors to the ends of the 100-ohm balancing control.

In the same article, the time constant of the phase-shift network in the feedback circuit should be 1 microsecond rather than 10 microseconds as stated in the fourth paragraph on Page 95.

We thank Robert Sharpe of Ames, Iowa, for calling our attention to these errors.

Question Box

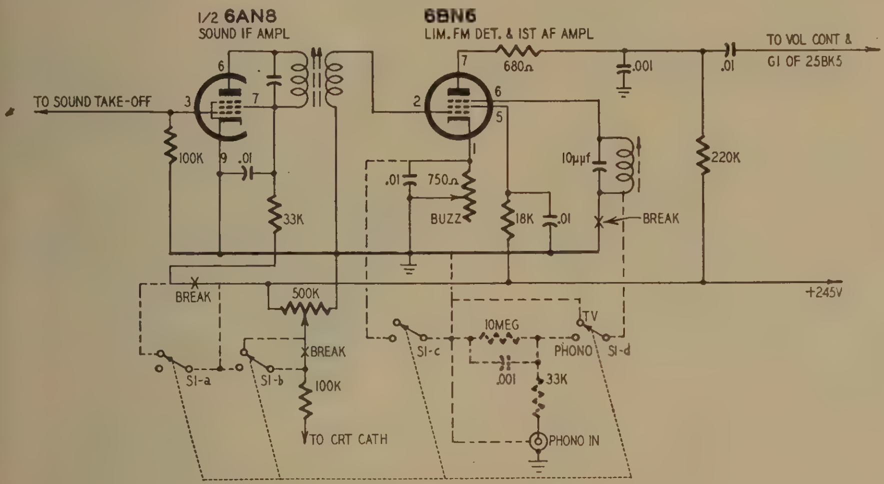
PHONO CONNECTION FOR TV

I am enclosing the diagram of my TV receiver. Please show how I can connect a record player and cut off the picture tube. I don't get enough gain when I feed the record player into the high end of the volume control in the grid circuit of the 25BK5 audio output tube.—R. N., Caracas, Venezuela

You can either use a phonograph preamplifier between the pickup and volume control or modify one of the existing r.f. or i.f. tubes so it serves as an audio amplifier for the phonograph.

The diagram shows the audio circuit of your TV receiver with the 6BN6 detector modified to work as an audio amplifier for phono reproduction. A 4-pole double-throw switch, two resistors and one capacitor are needed for the conversion.

S1-a opens the B plus line to the 6AN8 sound i.f. amplifier to prevent interference between the TV and phonograph. S1-b connects a high positive voltage to the cathode of the picture tube to darken the screen. S1-c grounds the 6BN6 cathode for proper operation as an audio amplifier and S1-d inserts the R-C network needed for connecting the pickup. Leads and components that must be added are shown by dashed lines.



CITIZENS BAND PROBLEMS?

Please print construction details and a schematic of a transceiver with a range of about 20 miles. I would like to use transistors and operate in the 465-mc citizens band.—A. C. B., Reno, Nev.

The citizens band is for the use of large numbers of citizens with no technical knowledge of radio so the FCC has set up very rigid specifications on transmitter stability, modulation capability and spurious radiations as well as on receiver reradiation to prevent avoidable interference and confusion.

The problem of successfully constructing citizens-band transmitters is not so much one of circuitry as it is one of layout and mechanical construction that must be used to meet the rigid technical requirements of the band. If you construct your own equipment you will have to satisfy the FCC that it fully complies with either class A or class B station requirements before a license will be issued. The commission may require you to send the equipment or a prototype to its laboratory for tests.

A considerable amount of experience with the design and construction of u.h.f. transmitters and receivers and precision laboratory equipment for checking transmitter characteristics are prime requisites for anyone attempting the construction of citizens-band 465-mc transmitters or transceivers. Therefore, we feel that it is very unlikely that amateur experimenters and constructors will be able to meet the FCC specifications for a number of years. Your best bet is to use commercial transceivers such as the Stewart-Warner model 73 *Portafones*.

Work with transistors has not progressed sufficiently for anyone outside of one or two laboratories to consider using them at frequencies much higher than the broadcast band, although some experimental transistors have been op-

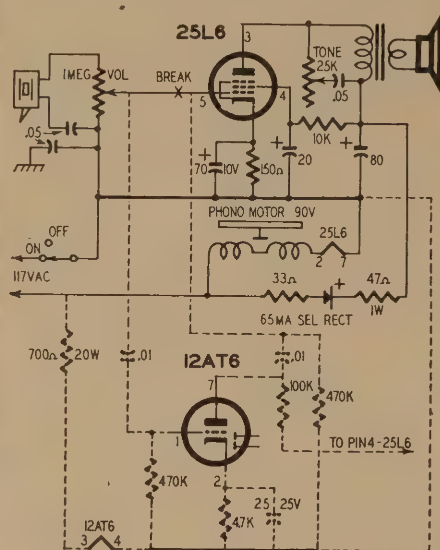
QUESTION BOX (Continued)

erated in the hundreds of megacycles. Construction and design of a satisfactory transistorized transceiver for frequencies as low as 2 mc are the result of many weeks of planning and experimenting. A few licensed amateurs have constructed transistorized transmitters for the 160-meter band. Power input is generally around 35 milliwatts and the range is about 2 miles with a good long-wire antenna and a sensitive communications receiver.

PHONO MODIFICATION

I am dissatisfied with my new record player because it does not have enough volume. I've heard less expensive units with more. All components and voltages check O.K. I'm sending the diagram of the player. Please show how I can modify it.—E. S. T., Brooklyn, N. Y.

According to the catalog data, the Astatic 16L3 cartridge in the play-



er develops about 4 volts output from the average record. The 25L6 tube requires a peak grid signal of 7.5 volts for maximum output of 2.1 watts. But since only 1 watt from a good speaker is too much for ordinary home listening, we feel that the output of the cartridge may have dropped considerably.

The first step is to check the cartridge output with a v.t.v.m. across the volume control.

If the average record produces voltages within normal tolerances, you can increase the output by increasing the gain with a voltage amplifier stage. The diagram shows the circuit of your amplifier with a 12AT6 preamplifier and its circuitry shown in dashed lines.

GOLDEN EAR CONTROL

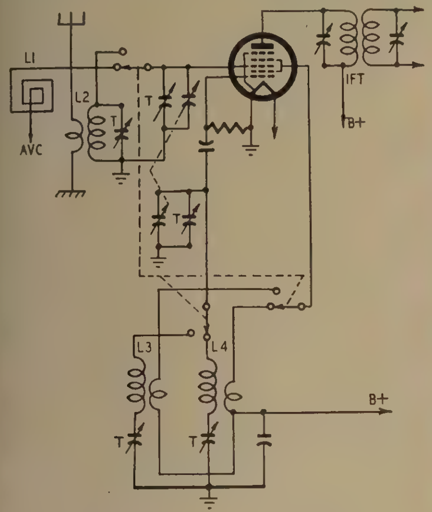
I'd like to use the Centralab C3-300 dual tone control that Mr. Marshall mentions for the Golden Ear control unit but I cannot find it listed in Centralab or mail-order catalogs. Please give the correct part number.—H. G., Willowbrook, Calif.

The C3-300 is a special unit not listed in general catalogs but readily available from Centralab distributors for $4.50.

MARINE-BAND CONVERSION

Several small-boat owners have asked me to convert typical 3-way portable broadcast receivers to receive the 2–3-mc marine band. Please print a diagram showing the alterations.—J. V. M., La Habra, Calif.

The diagram shows the front end of a typical 3-way or battery portable



with an added shortwave band.

L1 is the usual loop or high-Q ferrite antenna coil and L4 the broadcast oscillator coil. L2 and L3 are miniature antenna and oscillator coils, respectively, for the 2–6-mc band. A miniature 3-circuit 2-position wafer switch is used for shifting from one band to the other.

Note that many portables have a cut-plate oscillator tuning capacitor with a maximum capacitance of around 145 μμf while the antenna section has a maximum capacitance ranging from about 240 to 420 μμf. This 2-gang tuning capacitor should be replaced with one having a maximum capacitance of 365 μμf per section to insure tracking on the shortwave band.

RIAA COMPENSATION

Please print a diagram showing the modification of a G-E type A1-900 compensator to produce the new RIAA playback curve.—J. F., Brightwaters, N. Y.

G-E informs us that when the A1-900 compensator is used with the UPX-003A or similar preamplifier the AES curve runs within 2 db of the RIAA curve between 40 and 15,000 cycles so the AES position is satisfactory for the new curve.

It was also pointed out that the actual response of recordings may deviate several db from the theoretical because of studio absorption characteristics, orchestral balance, microphone directivity, tonal preference of the recording engineer and other factors. Remember also that curve deviations of several db may develop on playback where room acoustics, speaker response and the type of enclosure all have a direct bearing on playback characteristics. END

Patents

H. F. PROBE

Patent No. 2,685,673

Jack Avins, New York, N. Y. (Assigned to Radio Corp. of America)

Suitable for a v.t.v.m. or a scope, this probe features a triode cathode follower to isolate the signal and reduce loading.

An ideal probe network is shown in Fig. 1. When R1 × C1 equals R2 × C2, no frequency distortion exists. Values R2 and C2 are unavoidable, since they represent distributed quantities across the probe tube. Capacitor C1 is an isolating unit, and R1 must be added to preserve the time-constant relationship.

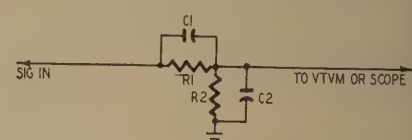


Fig. 1

In an actual probe, the ideal circuit is not obtained because of capacitance between the prod and ground. Instead of C1, capacitance exists directly to ground and a flat frequency response is not possible. Fig. 2 shows how this

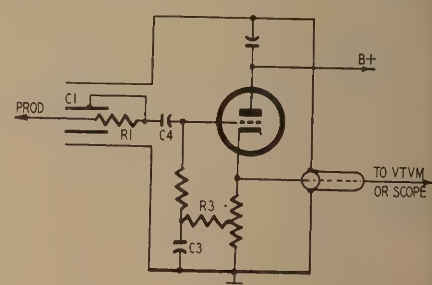


Fig. 2

invention solves the problem. An intermediate shield reduces capacitance between prod and ground and transfers the capacitance across R1 as desired. Blocking capacitor C4 is relatively large and R3-C3 is a filter that prevents feedback from cathode to grid. Values R2-C2 are not shown in Fig. 2, but they exist across the triode input.

WIDE-BAND TV ANTENNA

Patent No. 2,691,730

Yuen Tze Lo, Ellenville, N. Y. (Assigned to Channel Master Corp.)

This antenna has high gain, good directivity and uniform impedance over the entire v.h.f. band. It uses three dipoles, one tuned to about 65 mc and the others to about 195mc. Thus the antenna lengths are harmonically related. Fig. 1 shows the arrangement of the dipoles. The longest one is mounted between the other two.

At the lower end of the band the short dipoles contribute almost nothing, so only the longer antenna is effective. At the high end all three

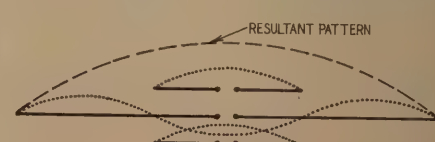


Fig. 1

dipoles pick up considerable energy. The dotted lines (Fig. 1) show the current distribution at the higher frequencies. As expected, the long dipole has an out-of-phase portion at the center, since it is a 3/2-wavelength wire. Ordinarily such a long wire cannot be used because of this phasing effect. In this case, however, the undesirable current distribution is cancelled by one of the shorter dipoles. This leaves the pattern shown by the dashed line. Thus the antenna acts just like a single dipole throughout the v.h.f. band.

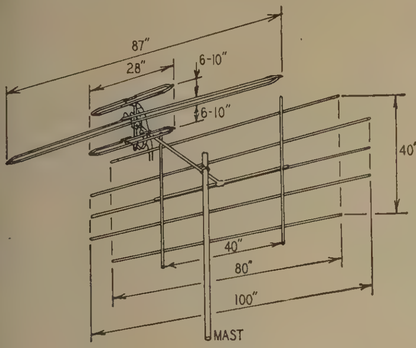


Fig.2

A complete antenna with reflector is illustrated in Fig. 2. The dipoles are of the folded type, the shorter ones being above and below the long dipole. The distance between dipoles is about 6–10 inches. Other dimensions are given in the diagram. The reflector is made of vertical and horizontal rods in back of the dipole array. It adds 7-db gain and increases directivity.

SPECIAL-EFFECTS CONTROL FOR AUDIO AMPLIFIER

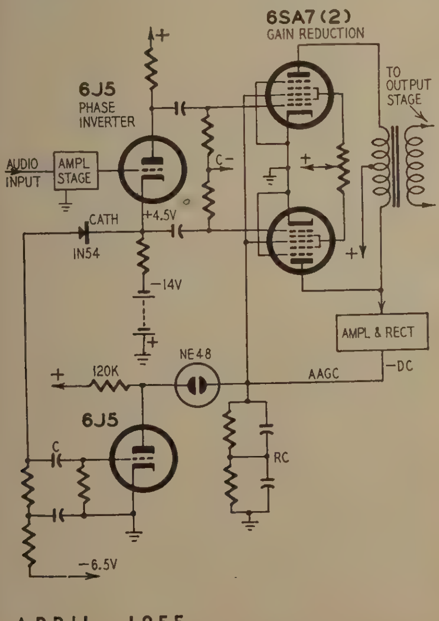
Patent No. 2,692,306

Jarrett L. Hathaway, Manhasset, N. Y., and Raymond E. Lafferty, Fair Lawn, N. J. (Assigned to Radio Corp. of America)

Amplifiers used for broadcasting and recording are often equipped with *automatic audio gain control* to prevent overloading and maintain a high percentage of modulation. The a.a.g.c. muffles louder sounds such as those of gunfire or thunder so the dramatic impact is lost. This new circuit passes these special effects by disabling the a.a.g.c. temporarily and automatically.

The audio signal is passed through an amplifier, an inverter and a gain control stage. Output from the lower 6SA7 feeds an amplifier–rectifier which provides a.a.g.c. bias. After R-C filters out the higher-frequency components, the bias is fed back to the 6SA7 grids.

The signal at the cathode of the inverter is transmitted through the 1N54 diode, which is normally blocked by two bias supplies. When a



very loud sound arrives, bias is overcome. The diode conducts *negative* pulses through capacitor C to a triode. The output of this tube consists of *positive* pulses. These ignite the NE48 neon bulb and neutralize the a.a.g.c. voltage. During the interval of the loud sound effect, the a.a.g.c. is disabled and the full blast of gunfire or thunder is transmitted through the amplifier.

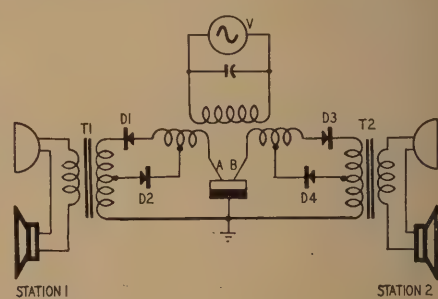
2-WAY TRANSISTOR AMPLIFIER

Patent No. 2,691,073

Roderic V. Lowman, Westbury, N. Y. (Assigned to Hazeltine Research, Inc., Chicago)

This amplifier transmits audio in two directions without need for switching. It is shown here connecting two stations, each equipped with a microphone and speaker. The transistor may be a junction or point-contact type. V is a source of a.c. at approximately 50 kc.

In the diagram, the transistor is assumed to be an n type point-contact or a p-n-p junction. During half the a.c. cycle, element A is driven positive while B goes negative. Therefore, during this time, A acts as emitter, B as collector, and the transistor amplifies in a left-to-right direction. D1 is blocked by negative bias. D2 conducts through the emitter-base path. During this half-cycle, D4 is blocked by a positive bias at its cathode. D3 conducts. Note that impedance relations are correct. The emitter load is only a portion of the T1 secondary, so it has low impedance. The collector feeds into the entire winding of T2.



During the next half-cycle of a.c., polarity is reversed. A acts as collector and B becomes the emitter. Signal transmission is now in the reverse direction, from station 2 to station 1. Impedance matching is correct again, for D2 and D3 are the diodes that block during this half-cycle.

Due to the rapid reversal of polarity of V, normal audio communication is readily carried on.

Most transistors are chemically formed so that one element (or point contact) makes a better emitter than the other element. In these cases transmission will not be equally effective in both directions. If this forming process is omitted, gain will be equal in both directions.

VOLTAGE REGULATION

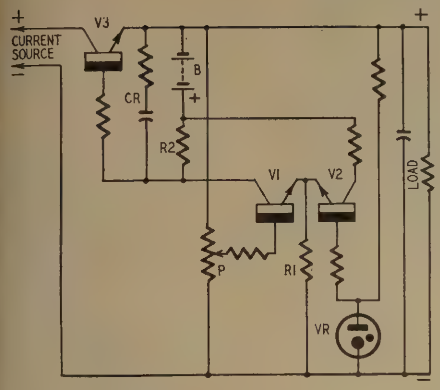
Patent No. 2,693,568

Fay H. Chase, Short Hills, N. J. (Assigned to Bell Telephone Labs., Inc.)

This voltage regulator uses transistors and operates on either d.c. or a.c. It is compensated against variations due to temperature.

Three n-p-n transistors appear in the diagram. V1 is the control unit. When the output voltage rises, for example, P feeds more positive potential to the base. In an n-p-n semiconductor this means greater conduction, so flow increases through R1, V1, R2, B. The increased current through R2 varies V3 bias and lowers its conductivity. V3 is in series with the load, therefore the tendency for the output voltage to rise is cancelled out.

When temperature rises, V1 conducts more easily and (as shown above) this means lower output voltage. To eliminate this variation with ambient temperature, V2 is added. The higher temperature increases its conductivity and this drives more current through R1. Therefore V1



is biased toward lower conduction, which, of course, cancels the temperature effect. Note that the bias for V2 is held constant by a V-R tube.

C-R prevents rapid changes of current from being amplified and fed back to cause "singing" and oscillation.

This circuit is also effective when the current source is a.c. In this case V3 rectifies the current, so the output is d.c.

WAVEGUIDE LINE

Patent No. 2,688,732

Winston E. Kock, Basking Ridge, N. J. (Assigned to Bell Telephone Labs., Inc.)

Recent patents have disclosed how a row of rods or pins can guide microwave energy. Such a guide line is shown in Fig. 1. Waves radiating from a rectangular horn are made to follow a line of rods to be received by a second horn. The rods may be of any good conductor such as copper or brass and may be held in place by wood posts or other insulators. In a typical line designed for waves of 3.2 cm, dimensions are:

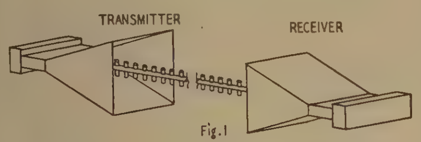


Fig. 1

rod diameter, 1/8 inch; rod length, 5/16 inch; spacing, 1/8 inch. Loss per meter length of line is only a small fraction of a db.

This invention deals with new applications for guide lines. Fig. 2 shows how to guide waves around a curve. Near the curve the rods

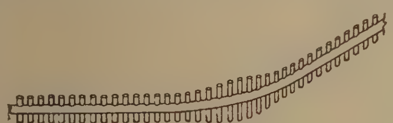


Fig. 2

must be made longer than usual to prevent the waves from going off into space. To change the polarization of a wave, the direction of the rods must be twisted gradually, from a vertical to a horizontal plane or vice versa. END

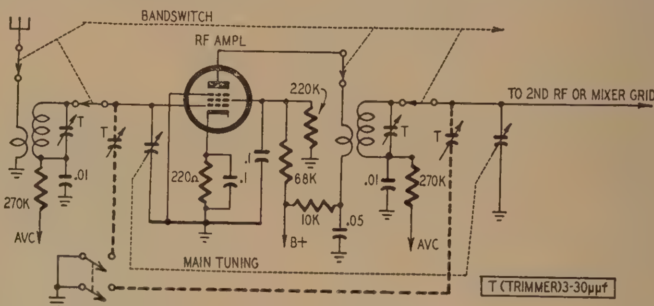
"Be sure you push it back to the kitchen before you come to bed!"

try This one

PEAKING SHORTWAVE SETS

Many all-wave sets do not track well on the 6–18- and 18–30-mc bands because of the high ratio of capacitance to inductance. This reduces the sensitivity on the low end.

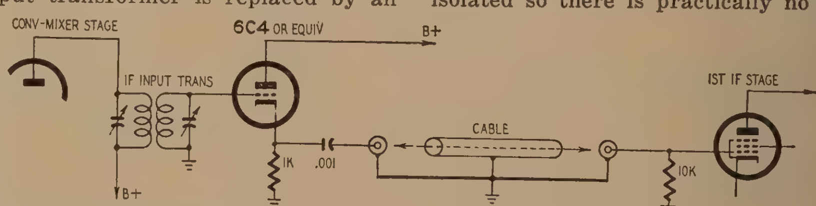
One way of keeping sensitivity up without major alterations is to connect 3–30-$\mu\mu$f variable trimmers across the antenna and r.f. coils through a switch as shown in the diagram. The switch should be opened so it won't degrade performance when listening on the high end of a critical band.



To touch up the alignment, tune in a signal at the low end of the band and peak it with the new capacitor. Now open the switch and adjust the high end according to manufacturer's instructions. This procedure, first applied to a Philco 645, has improved performance of communications receivers with amateur bands on the high and low ends of the tuning range.—*G. P. Oberto*

CONVERTER OUTPUT CIRCUIT

When constructing mobile shortwave receiving equipment, low-impedance link coupling is often used between the output of the tuner or a converter and the input to an i.f. channel on another chassis. However, it is often better to use a cathode follower as shown in the diagram. Here the usual converter output transformer is replaced by an i.f. *input* transformer and a 6C4 or similar triode is mounted on the converter chassis to feed the cable. The input to the first i.f. stage is not tuned.



This system has several advantages over link coupling:

1. Only one i.f. transformer is required as compared to two for link coupling.

2. This i.f. transformer is completely isolated from the cable so cable length and characteristics are not critical in any respect.

3. More efficient signal transfer is obtained.

4. The first i.f. stage has its input and output transformers completely isolated so there is practically no way for it to oscillate. Therefore, this stage can be run at higher gain than is otherwise possible, and we can easily overcome the losses in the cathode follower.

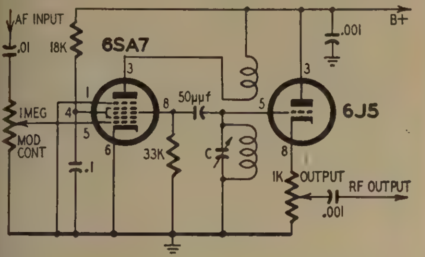
5. The components are standard, inexpensive and easy to obtain. The circuit is simple and completely noncritical. —*Charles Erwin Cohn*

TEST OSCILLATOR

While trying to find a substitute for the 6J5 cathode follower in the test oscillator in the June, 1953, issue (see diagram) I noticed that some triodes provide greater isolation between the oscillator and load than others. For example, when a 6SF5 is used the oscillator frequency shifts nearly 2 kc as the output control is varied through its range.

Greater stability with a greater number of tube types giving satisfactory performance as cathode followers is obtained by substituting R-C cou-

pling between the oscillator plate and the cathode-follower grid. Too, R-C coupling gives a slightly higher percentage of modulation. I found 250 $\mu\mu f$



and 1 megohm about right. Most convenient values can be used as long as the capacitance is kept fairly small.

With a broadcast antenna coil and 365-$\mu\mu f$ tuning capacitor in the circuit the generator produces useful harmonics up to 144 mc.—*Richard G. Strippel*

I.F. WAVE TRAPS

Miniature i.f. transformers (approximately ¾ inch square and 2 inches high) used in small AM, FM and personal portable radios used as unobtrusive shielded wavetraps for interfering signals in the i.f. range of receivers.

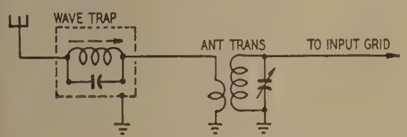


Fig. 1

If the set uses a hank or outdoor antenna, connect one of the parallel-tuned coils in series with the antenna lead-in as in Fig. 1. If the set has a loop or Ferrite rod antenna, disconnect the padder capacitor from one end of one of the transformer windings and use the assembly as a series-resonant trap between the grid terminal of the loop antenna and ground as in Fig. 2. Tune the coil for minimum interference.—*B. W. Welz*

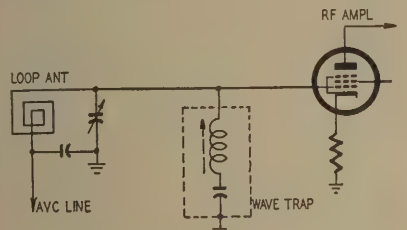


Fig. 2

MAKING SMALL CHASSIS

Old aluminum transcription discs provided excellent material for making small chassis and panels but I've not been able to do a good job of removing the coating. Discs that have one blank ungrooved side can be used to make panels that have a handsome glossy black finish.

The plastic coating has a tendency to crack and peel along bends and cut edges but this can be prevented by applying a little service solvent to these portions.—*Van H. Ferguson* END

Business

Merchandising and Promotion

Sprague Products Co., North Adams, Mass., brought out two new ceramic

capacitor kits for service technicians and laboratories. The new *Ceramikits* offer the most frequently used capacitors packaged in clear plastic boxes.

They are indexed with standup file separators. Catalog numbers and ratings can be clearly seen.

Quam-Nichols Co., Chicago, Ill., designed for use by its distributors a new envelope stuffer promoting its speakers.

Cornish Wire Co., New York City, is packaging its flat TV lead-in cable in a

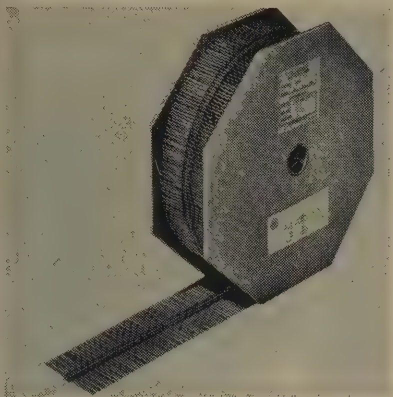
counter display carton which holds 10 100-foot coils.

Trio Manufacturing Co., Griggsville, Ill., is marketing its *Aristocrat* rotator control cases under a new plan which enables dealers or distributors to carry a complete stock in all four of the new colors without increasing their inventory. Four cases, each of a different color, are now packaged in one carton.

Vitramon, Inc., Bridgeport, Conn., is packaging its capacitors in a new pack designed for easier shipping and stocking.

John F. Rider Publisher, Inc., New York, is presenting its *Basic Electricity* book sets in a carton which doubles as a counter display.

Allen-Bradley Co., Milwaukee, Wis., is packaging its ½-, 1- and 2-watt fixed



resistors on a novel octagonal 12-inch reel.

Jensen Industries, Forest Park, Ill., is promoting its phono needles with a number of sales aids including the 1955 edition of its needle guide, a new silver-and-black card display, and its phono-needle wall chart.

Jersey Specialty Co., Mountainview, N. J., has launched a nation-wide sales contest to promote its lead-in wire

William and Peter Hagedoorn of Jersey Specialty Co., left, and two friends.

sales. Six grand prizes of trips to Bermuda will be awarded. Contest ends Aug. 10.

Calendar of Events

Fourth Regional Seminar for Parts Distributors, April 1–2, Paxton Hotel, Omaha, Neb.

Spring Assembly Meeting of the Radio Technical Commission for Aeronautics, April 5–7, Los Angeles.

Ninth Annual Spring Technical Conference of the Cincinnati Section of the IRE, April 15–16, Engineering Society of Cincinnati Building, Cincinnati, Ohio.

1955 Electronic Parts Show, May 16–19, Conrad Hilton Hotel, Chicago (closed show for parts distributors and allied personnel).

Production and Sales

RETMA reported that TV production for 1954 reached 7,346,715 units, second only to the record high of 7,463,800 sets in 1950.

RETMA announced that manufacturers had sold 9,913,504 picture tubes during 1954 to establish a new record. In 1954 385,089,458 receiving tubes were sold, compared with 437,091,555 in 1953.

New Plants and Expansions

Sangamo Electric Co., Springfield, Ill., acquired the assets of Gothard Manufacturing Co. in the same city.

BUSINESS *(Continued)*

The latter company now operates as Sangamo Generators Inc.

Ward Products Corp., Cleveland, Ohio, moved its Sales Department to its plant in Ashtabula, Ohio, under the same roof as the Engineering and Production Departments.

Raytheon Manufacturing Co., Waltham, Mass., is ahead of schedule in beginning the second stage of construction on its new electronics engineering and research laboratory at Wayland, Mass.

Western Electronics Institute, Hollywood, Calif., has completely modernized its shops and classrooms, following the RETMA recommendations as a guide.

CBS-Hytron, Danvers, Mass., established warehousing facilities for its TV picture tubes in Dallas, Tex., to serve the Southwest area.

Sylvania Electric has begun operations in the TV picture-tube plant in Hatboro, Pa., which it took over from National Union Electric Corp. David K. Elwell, formerly of the Seneca Falls plant, is now plant manager at Hatboro. Sylvania announced that practically all the National Union personnel have been retained. The company also announced that it had established an Electronic Systems Division with headquarters in Buffalo, N. Y., and laboratories in Mountain View, Calif., and Boston, Mass. Henry Lehne was appointed general manager of the new division. He was formerly director of Sylvania's Electronic Defense Laboratory in Mountain View, Calif.

Blonder-Tongue Laboratories, Westfield, N. J., opened an additional plant in Newark, N. J.

General Instrument Corp., Elizabeth, N. J., is building a new $1,500,000 radio-TV-electronic components plant in Statesboro, Ga., believed to be the industry's first major Southern plant.

Trav-Ler Radio Corp., Chicago, purchased the stock of Hallicrafters' Canadian subsidiary, Hallicrafters Canada, Ltd.

Gudeman Co., Chicago, moved its Sunnyvale, Calif., plant to a new larger building.

Superex Electronics moved its offices and factory to larger quarters in Yonkers, N. Y.

Recoton Corp. is now located in Long Island City, N. Y.

Thompson Products, Cleveland, Ohio, announced plans to build a $5,000,000 engineering study center in Euclid, Ohio.

Business Briefs

. . . **RCA** developed a new "automated" production machine for effecting time and cost savings in the manufacture of printed-circuit panels. The device is being made available to the entire industry.

. . . **Winegard Co.,** Burlington, Iowa, was assigned a patent covering several antenna constructions including its *Interceptor* antenna and *Electro-Lens* system.

. . . **Decision, Inc.,** Cincinnati, Ohio, published a new *Engineers Job Direc-*

tory designed to aid engineers in finding the right position by giving key facts about leading companies.

. . . **RCA** and **General Electric** have returned to 1-year warranties on TV picture tubes. Several other companies have followed suit.

. . . **Daystrom, Inc.,** Elizabeth, N. J., now has a majority stock interest in Weston Electrical Instrument, Newark, N. J.

. . . **Telrex, Inc.,** Asbury Park, N. J., received a patent covering its *Clover-V-Beam* TV antenna.

. . . **The 1955 Western Electronic Show and Convention (WESCON)** will be held August 24–26 in the San Francisco Civic Auditorium.

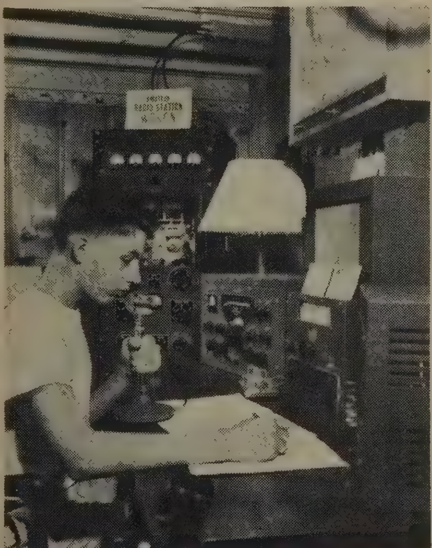
. . . **Ram Electronics Sales Co.,** Irvington, N. Y., completed arrangements with Howard W. Sams & Co., Indianapolis, for listing its TV sweep components in the Sams' Photofact folders.

. . . **The 1955 British National Radio Show** will be held at Earls Court, London, August 24–September 3.

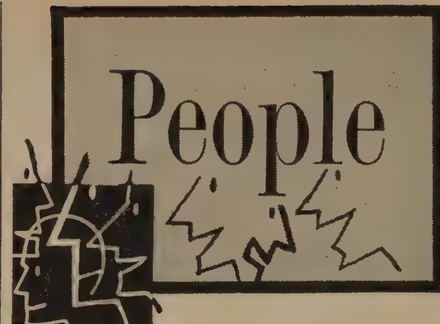
. . . **The German Radio, Phone and TV Exhibition** will be held in Düsseldorf, August 26–September 4.

. . . **RETMA** filed a petition with the FCC requesting a stay in the effective date of the new "type acceptance–type approval" rules for nonbroadcast transmitting equipment. The association suggested that an industry-Government committee be set up to resolve some of the problems of the rules as now written. END

TRANSPACIFIC LINK



Phil Anderson, W7SGN, 13-year-old Portland, Ore., ham at the mike of the 700-watt phone-cw rig that he shares with his 18-year-old brother Lloyd, W7REW. An ardent dx'er and traffic man, Phil devotes most of his operating time to handling traffic to and from GI's overseas. A phone patch permits many servicemen to speak directly to loved ones at home. One such conversation lasted for an hour and ran up a bill of $100 in long-distance telephone toll charges.



G. Barron Mallory was elected a director of P. R. Mallory Inc., Indianapolis, to fill the vacancy created by the death of Richard C. Hunt. **Frank B. Powers,**

F. B. Powers

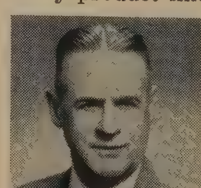
G. M. Arisman

former vice president in charge of manufacturing, was appointed operating vice president of the company and **George M. Arisman, Jr.** was elected controller.

Hugo Cohn, executive vice president of Radio Receptor Co. Inc., New York, was elected president of the company, succeeding **Ludwig Arnson** who is retiring as president but remaining as a director and consultant. **Harold R. Zeamans** was appointed secretary-treasurer of the company.

Dr. Rudolf G. E. Hutter was appointed manager of the Physics Laboratory of Sylvania Electric Products, Bayside, N. Y. He formerly managed the Physical Electronics Branch of the Physics Laboratories.

David W. Potter, formerly product line manager of semiconductors, was named sales manager of the Components Division of Federal Telephone and Radio Co., Clifton, N. J.

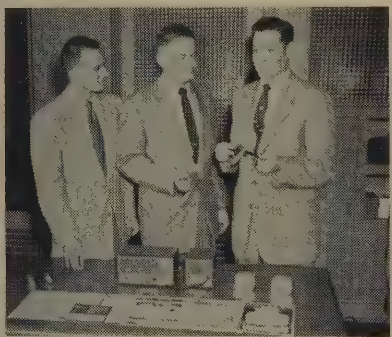


Howard S. Orcutt joined Pyramid Electric Co., North Bergen, N. J., as chief engineer of the Rectifier Division. He came to Pyramid from Federal Telephone & Radio Co.

Dr. A. Melvin Skellett has been named director of color television tube planning and development for Tung-Sol Electric, Newark, N. J. Dr. Skellett has been active in research and administrative capacities in the electronics industry for the past 25 years. He holds over 70 major patents in electronics.

Floyd Reid has been named a development engineer of ORRadio Industries, Opelika, Ala. His career in electronics goes back almost 30 years. He recently headed his own firm which developed and manufactured a new type of electronic laminating machine. Reid began his career with Atwater Kent in 1927.

Joseph H. Gibbs was promoted to assistant sales manager of Blonder-Tongue Laboratories, Westfield, N. J.



Left to right: Blonder-Tongue's Joe Gibbs, Bernard Coler and Joe Kerner.

Bernard A. Coler joined the firm as a sales engineer. Gibbs has been with the company for over two years. Coler came to Blonder-Tongue from RCA.

Obituaries

H. Ward Zimmer, president of Sylvania Electric Products and a pioneer in the electrical electronics industry, died recently in New York City after a brief illness.

Charles J. Pannill, a former president of Radiomarine Corp. of America and RCA Institutes and a pioneer in the communications field, died at Harkness Pavilion, New York City, at the age of 75.

Raymond Machlett, founder of Machlett Laboratories, radio and TV transmitting tube manufacturer, died at his home in New Canaan, Conn.

Personnel Notes

. . . **Len Lockwood** was appointed national field sales manager of the Winegard Corp., Burlington, Iowa, manufacturer of TV antenna products.

PEOPLE *(Continued)*

. . . **F. P. Rice**, formerly manager of the cathode-ray tube division, was appointed to the newly created position of director of manufacturing and purchasing for Allen B. Du Mont Laboratories, Clifton, N. J.

. . . **Rayford E. Nugent** was named general sales manager of the Philco Parts and Accessories Division, Philadelphia. He was formerly division manager of the Southeast Division. **William J. Horn**, previously in charge of air conditioning and electric range advertising of Philco's Appliance Division, was promoted to merchandising and advertising manager for the Parts and Accessories Division, filling the vacancy created by the death of Robert N. McKinney some months ago.

. . . **Brig. Gen. Peter C. Sandretto** and **A. G. Clavier** were appointed assistant vice-presidents of Federal Telecommunication Laboratories, Nutley, N. J. Both were formerly technical directors of the company.

. . . **Stanley A. Baum**, auditor for Allied Radio Corp., Chicago, for the past two years, was named comptroller of the company. **Goodwin G. Mills**, formerly a captain in the U. S. Army Research Group, joined Allied as manager of the Electronic Kit Dept. **Leonard S. Preskill** was appointed product development manager of the company. He previously handled mailing lists research.

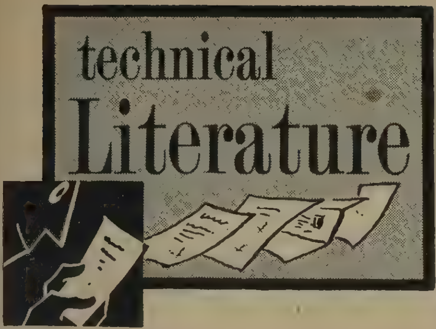
. . . **Doug Carpenter**, chief antenna engineer for JFD Manufacturing Co., Brooklyn, N. Y., has been selected by RETMA to head a committee to rewrite Article 810 of the National Electric Code which deals with installation techniques for transmitting and receiving TV antennas, accessories and masting and amateur radio transmitting and receiving systems.

. . . **Norma L. Testardi** was appointed advertising manager of International Resistance Co., Philadelphia. She has been active in the field of television and served as publicity director for the American Philatelic Congress.

. . . **R. S. Fenton**, formerly vice president and general sales manager of Permoflux Corp., Chicago, has assumed the duties of vice president in charge of sales and engineering in an expansion of the company's management structure. Other appointments include **Frank Newberg**, manager of manufacturing; **Edward Watermulder**, administrative manager; **Sam Hyman**, chief commercial engineer; **Walter Padgett**, chief engineer. **G. W. Adams** continues as superintendent and **M. F. Heineman** as secretary-treasurer.

. . . **William Dubilier**, founder of Cornell-Dubilier Electric Co., South Plainfield, N. J., was selected by the Alumni Association of Cooper Union to receive the first annual Gano Dunn Medal to be awarded every year to an alumnus for outstanding professional achievement.

. . . **B. B. Bauer**, vice president of Shure Brothers, Chicago, was elected a Fellow of the Audio Engineering Society. END



AUTO RADIO TRANSFORMERS

Stancor's 8-page *Auto-Radio Replacement Guide No. 500* lists both vibrator-power and audio-output replacements for over 540 car radios. It includes all models used by the major automobile manufacturers as well as private label brands. More than 40 manufacturers are listed and cross-referenced. Information as to the year each model was used is also included. A separate catalog page lists detailed specifications on 25 vibrator power transformers, including 21 exact replacements, and 19 audio outputs used in car radios.

Chicago Standard Transformer Corp., Addison & Elston Sts., Chicago 18, Ill.

TV ANTENNAS

TV antennas and accessories are described and illustrated in RMS' 25-page *Catalog No. 55A*. It is completely indexed, and gives list prices for each item shown.

Radio Merchandise Sales, Inc., 2016 Bronxdale Ave., New York 62, N. Y.

Any or all of these catalogs, bulletins, or periodicals are available to you on request direct to the manufacturers, whose addresses are listed at the end of each item. Use your letterhead—do not use postcards. To facilitate identification, mention the issue and page of RADIO-ELECTRONICS on which the item appears. UNLESS OTHERWISE STATED, ALL ITEMS ARE GRATIS. ALL LITERATURE OFFERS ARE VOID AFTER SIX MONTHS.

HIGH-FIDELITY CATALOG

Allied's 68-page booklet *This Is High Fidelity* contains an illustrated section explaining high fidelity, with comprehensive up-to-date listings of hi-fi music systems and separate components. The functions of the basic units used in home hi-fi music systems are discussed in nontechnical language. Tips on what percentage of the hi-fi dollar to appropriate to each component and on how to save money in the selection and installation of components are also given. Completely illustrated matched hi-fi systems are shown in numbers.

Allied Radio Corp., 100 N. Western Ave., Chicago 80, Ill.

MAGNETIC TAPE

An 8-page booklet No. 190 on *Scotch* magnetic tape discusses playing time, tape strength, reel sizes, recorder settings and performance characteristics of new *Extra Play* magnetic tape.

Minnesota Mining & Mfg. Co., 900 Fauquier St., St. Paul 6, Minn.

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LOUDSPEAKER

Jensen's *Bulletin No. 1001* describes their new miniature loudspeaker P275-Y. All technical information and specifications are given.

Jensen Mfg. Co., 6601 S. Laramie Ave., Chicago 38, Ill.

RADIO INTERFERENCE FILTERS

A 22-page catalog discusses the *Filtron* type FSR r.f. interference suppression filters for use in screen rooms, induction heating equipment, diathermy and X-ray units or similar equipment. Detailed information on each filter is given by cutaway views, dimension drawings and descriptive text. Graphs of attenuation characteristics and complete engineering data on every unit specify the right filter for any particular application.

One section of the two-color catalog shows accessories, such as filter assembly boxes, waveguide fittings and enclosed safety switches, and discusses installation information and design considerations.

Filtron Co., Inc., Flushing, L. I., N. Y.

AUTOMATION DICTIONARY

This little dictionary covers some 87 words and phrases, all of which originated with engineers but are now creeping into the lexicon of today's businessman. Each word is defined in simple language to enable the nontechnical individual to better understand the language engineers speak.

Mr. W. Lang, Brown Instrument Div., Minneapolis-Honeywell Regulator Co., Wayne & Windrim Aves., Philadelphia, Pa.

TRANSISTORIZED WRIST RADIO

A 4-page *Bulletin PB 111461* describes the transistorized wrist radio referred to in our March, 1954, issue (page 82). All technical information as well as a schematic is given.

U. S. Department of Commerce, Office of Technical Services, Washington 25, D. C. 25 cents. END

Radio Thirty-Five Years Ago

In Gernsback Publications

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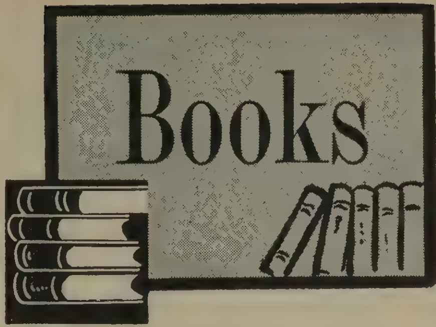
Electrical Experimenter	1913
Radio News	1919
Science & Invention	1920
Television	1927
Radio-Craft	1929
Short-Wave Craft	1930
Television News	1931

Some of the larger libraries still have copies of ELECTRICAL EXPERIMENTER on file for interested readers.

In April, 1921, *Science and Invention (formerly Electrical Experimenter)*

Radio Relayed Over Land Lines
The Audio-Frequency Amplifier in France, by Robert E. Lacault
Radio Transmission Phenomena by Amateur Radio Operators



BASIC TELEVISION, PRINCIPLES AND SERVICING (Second Edition), by Bernard Grob. McGraw-Hill Book Co., Inc., 330 W. 42 St., New York, N. Y. 6 x 9 inches, 662 pages. $6.

Although the title of this book seems to indicate a balance between theory and practice, it is more concerned with an explanation of how television works. This is a job that the book does extremely well. A careful study will supply technicians with a very desirable background of TV theory.

In a very readable fashion, the book covers television transmission and reception, the formation and use of sync and video signals, amplitude and frequency modulation, picture tubes, tuners, a.g.c., antennas, etc. You will also find a rather thorough stage-by-stage analysis of picture receiver circuits. Part of the material that appeared in the first edition, and now out of date, has been deleted. In line with the trend in our industry, the author has added a completely new section on color TV. —*MC*

ELECTRICAL APPLIANCE SERVICE MANUAL, by William Gabbert. Rinehart & Co., Inc., 232 Madison Ave., New York 16, N. Y. 5½ x 8½ inches, 372 pages. $5.

Some men, if called service technicians, will take this description quite literally and try to repair everything in sight. Whether you want to be strictly a radio and TV technician or a jack-of-all-electrical-work is mostly a matter for personal choice. If you like to vary the routine of radio and TV repair with odd jobs on electrical appliances, then you'll find this book interesting, helpful, valuable.

Well written and clearly illustrated, the book describes the repair of toasters, irons, hotplates, roasters, sandwich grills, washing machines, vacuum cleaners, electric ranges, electric clocks, water heaters, fluorescent lamps, etc. In other words, practically any home appliance that can be plugged into an outlet (but which should be fixed first) is covered in this book.—*MC*

THE OSCILLOSCOPE, by George Zwick. Gernsback Publications, Inc., 25 W. Broadway, New York, N. Y. (No. 52, Gernsback Library) 5½ x 8½ inches, 192 pages. $2.25.

The oscilloscope is the radio-TV service technician's most useful but most complicated instrument. Every technician who uses one should, of course, know all about the scope itself. He should also know how to connect

it to any circuit he is testing and how to interpret the results he sees. This book gives complete, practical information. It is useful to beginners as well as more experienced workers. Diagrams and schematics round out the detailed information.

After describing the cathode-ray tube and its circuits, the author goes into scope applications. He tells how to align radio i.f., FM discriminators, video channels; how to measure frequency and phase difference, etc. Step-by-step information makes the procedures easy to follow.

The last chapter lists various experiments that can be made with a scope. This data can do much to dispel the mystery surrounding an oscilloscope.—*IQ*

ANALYZING AND TRACING TV CIRCUITS, by Milton S. Kiver. Howard W. Sams & Co., Indianapolis, Ind. 8½ x 11 inches, 145 pages. $3.

A far cry from Kiver's usual efforts, this book does not fill any particular need in the television field. The text is highly disconnected, jumping from one section of a TV set to another without any apparent continuity. The experienced service technician will find very little of interest, and the inexperienced technician may have difficulty piecing together the various chapters into an effective educational instrument. For the student, the book is entirely inadequate, theory being incomplete.

Individually each of the 10 chapters is well written, but they vary greatly in technical level. Some are extremely simple—things you should know about every circuit and differences between schematics and sets. Then, giving the reader no preparation, Kiver delves deeply in chapters on where the boost voltage fits in and the a.g.c. system. The appendix contains schematic diagrams of 14 TV receivers.

In reading through the text, the average technician will no doubt find information of technical value to him in his work. However, the probability is that the benefits derived from reading the book will not be worth the time spent. The 14 large schematics supplement the text nicely.—*JK*

METALLIC RECTIFIER MANUAL, prepared by Verlan Books, Inc. for Bradley Laboratories, Inc., New Haven, Conn. 128 pages, $2.

Primarily prepared for the design and development engineer, this 128-page loose-leaf handbook on selenium and copper-oxide rectifiers deals with rectifier types, designs, circuitry, characteristics and applications. Included are details and circuits on such unusual applications as modulators, current limiters, arc suppressors, voltage regulators, dynamic brakes for motors and meter overload protectors.

To prevent its becoming outdated, the publisher will mail to all owners revisions and additions as they are warranted by developments in the field.

RADIO-CONTROL HANDBOOK, by Howard G. McEntee. Gernsback Publications, Inc., 25 W. Broadway, New York 7, N. Y. 5½ x 8½ inches, 192 pages. $2.25.

This handbook complements a previous book *Model Control by Radio* (Gernsback Library No. 43). The present work covers the more simple circuits, mostly one- and two-tubers. It also gives detailed, practical instruction for planning a control system, construction, operation and trouble shooting. It even describes the procedure for obtaining a Citizens band license. It will satisfy a beginner as well as an experienced hobbyist.

The first few chapters are concerned with mechanical details. Plan views give clear information on escapements, relays, rudder controls and actuators. These are followed by chapters on electronic circuits. Simple yet reliable receivers and transmitters are shown by diagram and photo. Readers will appreciate the clear pictorial views which show how to lay out small parts in limited space. The sets are for operation in either the 27-mc Citizens band or the 50-mc ham band. Pulse and tone control are covered.

The last few chapters discuss the installation and maintainance of the system. Direction finding, power measurement of r.f. output and relay adjustment are among the topics.—*IQ*

FUNDAMENTALS OF TRANSISTORS, by Leonard Krugman. John F. Rider Publisher, Inc., 480 Canal St., New York 13, N. Y. 5½ x 8½ inches, 140 pages. $2.70.

Probably no other word in the entire history of electronics has suffered as much abuse as "fundamentals." To many, fundamentals means exactly that—a simple or basic approach. However, the amount of mathematics in this book would seem to take it out of the fundamental class, there just doesn't seem to be any other way of dealing with this subject.

Well written, with every evidence that the author has done a very creditable job, the book starts quite logically with semiconductor physics and continues through transistor operation, grounded base, emitter and collector circuitry, amplifiers and oscillators. An excellent advanced book for learning about transistors.—*MC* END

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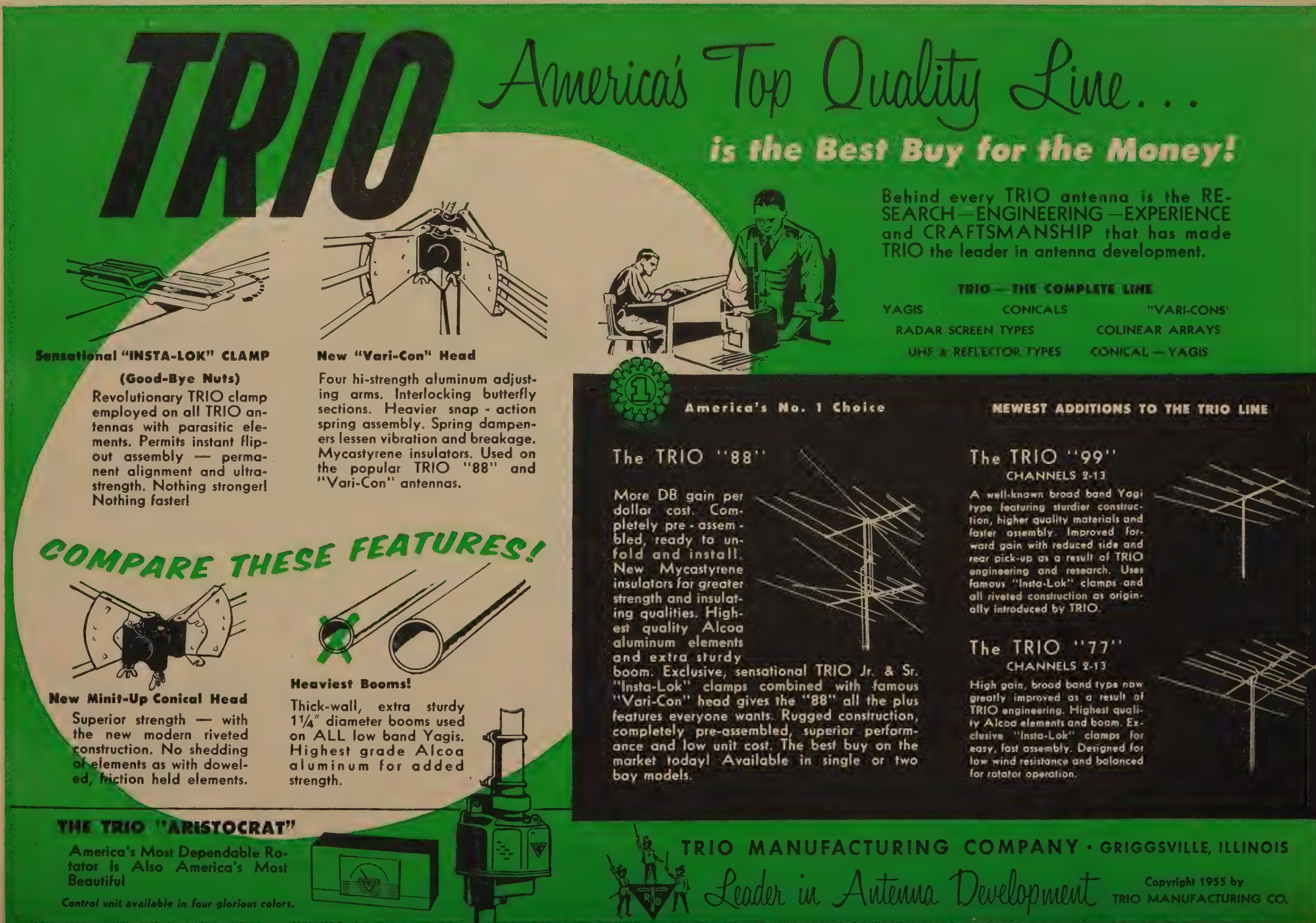

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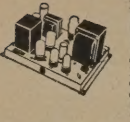

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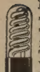

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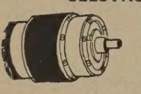

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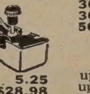

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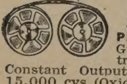

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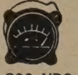

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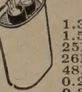
Brach MCD4 Neon Arrestor......**3/$1.00**
Isol. Transformer VS 110 to 220 or 440/150 watt ......**$4; 2 for $7**
Globar T2FD/350ohm/500W RF Ant. Resistor & Clips......**$2.00**

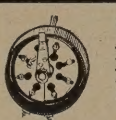
NEW OIL CONDENSERS
FRESH STOCK



1.3MFD/2400WVDC ......$1; 4/$3
1.5MFD/3000WVDC ......$2; 3/$5
25MFD/1000WVDC ......$8; 6/$36
26MFD/1000WVDC ......$8; 6/$38
48MFD/1000WVDC ....$11; 2/$18
0.25MFD/1200WVDC 30c; 20/$3
0.38MFD/2400WVDC 29c; 25/$3

866A KIT (2) 866A Tubes, Sockets & Transformers—$4.98

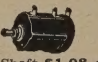
RHEOSTAT BUY



15 Ohm 25W....$1.10; 10/$7
50 Ohm 25W....$1.10; 10/$7
75 Ohm 25W..$1.98; 10/$14
125 Ohm 25W....$1.10; 10/$7
250 Ohm 25W....$1.10; 10/$6
500 Ohm 25W....$1.10; 10/$7
1200 Ohm 225W..$2.98; 2/$5
5000 Ohm 25W **$1.25;** 10/$9
Write for Quantity Prices

KIT • MICROSWITCHES
Asst'd 4 for $1, 20 for $4

PRECISION LAB POTENTIONMETERS



Wire Wound, 20,000 Ohm, 2¾" Dia./4" Shaft **$1.98** ea. ......2/$3.50
MICROPOT 20,000 ohm/.01%......$5.49

"TAB" SPECIALS

Blower Turbine Type 50 CFM. 28VACDC, Excel. for 4x Eimac Tubes & Others. Dia. 3" self lubricating bearings, cont. service, rugged design. Only **$4.98** ea. w/115VAC Xfmr **$5.98,** Lots of 3 @ **$15.**
Hook Up Wire Asst'd 5 Colors, 100 ft. per roll, 500 ft. **Spec. $1.98,** 6 for **$10.**
Clamp Lamp (Adj); w/Bulb & Refl **$1.59,** 7/$10

● IT'S "TAB" FOR TOOLS ●
Famous Soldering Guns

TA S-4 Gun 135W......$7.89
TA 10 Gun 180W......$5.83
TA D-4 100-150W......$9.65
TA D-5 200-275W....$10.53
LENK GUN—The Best..$7.45

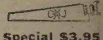
Speedway Electric Drills

200J ¼" Electric drill w/Chuck......$14.25
400J ½" Electric drill w/Chuck......$29.95

New Swiss "QUICKIE" Wrench

10 WAY wrench w/1001 uses. Fits 95% all sizes Sq. & Hex Head nuts & bolts ¼" to 9/16". **RUSTPROOF.** GTD; Brkproof (Postpaid U.S.A.)......6/$5

Swedish Hand Saw

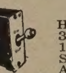


FINEST SWEDISH STEEL
Genuine Sandvick Grade
24 to 30" long
Cross Cut $10.98 Reg. **"TAB" Special $3.95**

COMPONENT KITS

Resistors 100 Asst'd .95 ea, 6/.85 ea
Tube Sockets 20 Asst'd .85 ea. 6/.75 ea
Ceramicon Cond. 25 Asst'd....6/.75 ea.
Vit WW Res. 15 Asst'd ....6/$1.25 ea
Rotary Sw. 12 Asst'd .95 ea, 6/.85 ea
Knobs 10 Asst'd.... .98 ea, 6/.89 ea

CIRCUIT BREAKERS



He'nmann Magn Bkrs. **Amps;** .220, 3, 5, 7, 9, 10, 12, 30, 40, 80, 180, ea, **$1.98;** 12/ **$20** 50/**$75**
Sq D & CH Toggle Sw. Bkrs, Amps; 5, 10, 15, 20, 25 @ **98c;**
Klixon Therma Push Button Bkrs. **Amps;** 5, 10, 15, 20, 25, 30......**89c;** 10/**$7.98**

4MFD/1200VDC or 10MFD/600VDC (OR ASST'D) Lots of 12 $1.50; Singly $1.79

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● Hickock Mu Tested 1 Yr. Gtd. ● Full RETMA Warranty ●

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1R5 .58, 1S4 .88, 1S5 .66, 1T4 .68, 1T5 .98, 1U4 .54, 1U5 .68, 1V2 .68, 1X2A .88, 1Z2 2.05, 2A4 2.37, 2A7 .89, 2B7 .89, 2V3 2.90, 2W3 1.95, 2X2 .54, 3A4 .48, 3A5 .86, 3B4 2.70, 3B5 2.35, 3Q4 .46, 3Q5 .68, 3S4 .66, 3V4 .79, 5AN8 1.05, 5AW4 1.37, 5AZ4 .54, 5R4GY .96, 5T4 1.48, 5U4 .54, 5V4 .89, 5W4 .71, 5X4 .78

5Y3 .42, 5Z3 .81, 5Z4 1.29, 6A3 1.29, 6A4 3.15, 6A5 3.89, 6A7 1.09, 6AB4 .62, 6AB5 1.65, 6AB7 .78, 6AC5 1.19, 6AC6 .95, 6AC7 .68, 6AD7 1.47, 6AF4 1.35, 6AF6 1.18, 6AG5 .71, 6AG7 1.14, 6AH4 .87, 6AH6 1.18, 6AJ5 1.77, 6AK5 .62, 6AK6 .74, 6AL5 .48, 6AL7 1.22, 6AM8 1.27, 6AN4 1.55, 6AN6 .85, 6AN8 1.25, 6AQ5 .52, 6AQ6 .54

6BQ7 1.25, 6BX7 1.25, 6BY5 1.59, 6BZ7 1.27, 6C4 .46, 6C5 .68, 6C6 .56, 6C8 .82, 6CB6 .58, 6CD6 1.58, 6CF6 1.25, 6CL6 1.65, 6CR6 .80, 6CS6 .99, 6CU6 2.29, 6D4 2.65, 6D6 .84, 6E5 1.09, 6E7 3.49, 6F4 2.79, 6F5 .91, 6F6 .76, 6F7 1.01, 6G6 .92, 6H6 .57, 6J4 4.59, 6J5 .46, 6J6 .58, 6J7 .72, 6K4 2.77, 6K6 .61

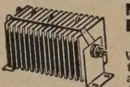
6K8 1.21, 6L5 1.09, 6L6G 1.17, 6L7 .80, 6N4 2.05, 6N6 3.85, 6N7 .80, 6P5 .99, 6Q7 .81, 6R7 .81, 6S4 .99, 6S7 1.30, 6SA7 .67, 6SC7 .74, 6SF5 .78, 6SF7 .74, 6SG7 .62, 6SJ7 .69, 6SK7 .54, 6SL7 .62, 6SN7 .59, 6SQ7 .56, 6SR7 .89, 6SS7 .89, 6SZ7 1.25, 6T4 1.35, 6T8 .82, 6U5 .99, 6U8 1.09, 6V3 1.90, 6W4 .38

6W6 .85, 6X4 .42, 6Y7 2.11, 6ZY5 .90, 7A4 .78, 7A6 .89, 7A7 .79, 7A8 .68, 7AD7 1.41, 7AF7 1.09, 7AG7 .99, 7AH7 1.10, 7B4 .81, 7B5 .71, 7B6 .72, 7B8 .76, 7C4 .79, 7C5 .72, 7C6 .68, 7C7 .64, 7E5 .54, 7E6 .72, 7E7 .82, 7F7 1.18, 7F8 .72, 7H7 1.35, 7K7 1.21, 7L7 1.19, 7N7 .90, 7Q7 1.01, 7R7 1.35, 7S7 1.29, 7T7 1.03, 7V7 1.06, 7W7 1.31, 7X6 .89, 7Y4 .64, 7Z4 .71, 12A5 1.49, 12A6 .48, 12A7 1.19

12A8 .79, 12AC7 1.19, 12AH7 .92, 12AL5 .54, 12AT6 .46, 12AT7 .82, 12AU6 .61, 12AU7 .58, 12AV6 .52, 12AW6 .84, 12AX7 .76, 12AY7 1.22, 12AZ7 .95, 12B4 .95, 12BA6 .69, 12BA7 .94, 12BE6 .62, 12BF6 .59, 12BH7 .99, 12C8 .62, 12F5 .79, 12H6 .48, 12J5 .48, 12J7 .99, 12K8 .48, 12SA7 .64, 12SC7 .78, 12SF5 .79, 12SF7 .78, 12SG7 .91, 12SH7 .62, 12SJ7 .54, 12SL7 .62, 12SN7 .81, 12SQ7 .54, 12SR7 .46, 12Z3 .89, 14A5 1.99, 14A7 .89, 14F7 .95, 14N7 1.09

14Q7 .99, 14R7 1.31, FG17 3.01, 19 .89, 19BG6 1.98, 19T8 1.49, 19V8 1.96, 24A .92, 25A6 1.79, 25BQ6 1.11, 25L6 .46, 25Y5 .84, 27 .69, 35A5 .71, 35B5 .54, 35W4 .45, 35Y4 .68, 35Z3 .69, 35Z4 .64, 35Z5 .47, 36 .64, 37 .58, 43 .79, 45 .45, 45Z3 .89, 48 2.02, 50A5 .72, 50B5 .71, 50C5 .54, 52 1.61, 70A7 1.60, 71A .74, 73 1.67, 75 .82, 76 .68, 78 .78, 83V 1.22, 85 .79, 117N7 1.97, 117Z4 1.15, 117Z6 1.09

NEW "TABTRON" SELENIUM BRIDGE RECTIFIERS DATED & GTD



We mfr. Power Rectifiers to your specs. From 1 amp. up to and above 1000 amps. Following List. Full Wave Bridge. Dated **1 YR. GTD.**

Curr. Cont.	18/14 Volts	36/28 Volts	72/56 Volts	130/100 Volts
1AMP	1.35	2.35	4.50	8.35
2AMP	2.00	2.75	5.90	10.30
3AMP	2.95	4.15	7.90	12.90
4AMP	3.50	7.35	14.35	25.00
6AMP	4.25	8.75	17.30	32.80
10AMP	6.30	12.85	24.80	41.50
12AMP	7.90	15.75	29.75	45.75
20AMP	13.05	25.05	48.75	78.50
24AMP	16.05	31.95	57.65	85.00
30AMP	19.50	37.60	71.00	110.00
36AMP	23.75	47.75	86.95	135.00
50AMP	31.00	61.50	105.75	175.00

New Rectifier & Trans Combo

115V/60 cy inputs.
up to 14VDC at 12 Amps......$ 19.98
up to 28VDC at 5 amps...... 15.65
up to 28VDC at 12 amps...... 29.98
up to 28VDC at 24 amps*...... 59.98
up to 28VDC at 50 amps*...... 117.98
up to 28VDC at 100 amps*......199.00
*Transformer has 115&230V PRI

Variable DC Power Supply

Full Wave rectification, 6000Mfd filter Condenser, fused. 6.3V or 12.6V at 2 amp. operates 115V/60cy.
Model 2DCF......$12.98
As above except 5 Amp Model 5DCF......$29.95
5DCF ACC/5A/1% Ripple......$32.00

HEAVY DUTY BATTERY "FAST" Charger Rectifier

13-0-13V(CT) 100 Amp Fan Cooled or 34 Amp Air Cooled—Repl'mt 6V Booster Charger. **Model CR16......$10; 3/$27**
16-0-16V (CT) Fan Cooled. For 12V/60A and 6V/100A Booster Chargers.
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Convert Your 6V "Fast" Chgr.

to 12V/50A as well as 6V/100A use Details and Rectifier..**$22.00 ea.; 3 for $60**
BCT 2/1A 2V Battery "TR" Chgr **$3.98**
BCT 6-12/2A 6&12V Batt."TR" Chgr **$7.98**

New Rectifier Chokes

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CH2/2AMP/0.1HY/.67R/3# $5.95
CH07/5AMP/.07HY/.6R/10# $7.95
CH01/12AMP/.01HY/.1R/12# $14.95
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CH001/50A Hipersil Core......$54.00
CH0035/70A/.0035Hys/.0096R $66.00

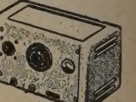
Now Power Your Gov't Surplus

Receivers and Transmitters From The Set Power Pack or Dynamotor
B28V/5A for ARC5, BC312, 342, 348..$35
B28V/24A for BC654 or BC375......$110
B12V/50A for BC191......$110
B28V/100A for ART13......$395

New Rectifier Xfmrs

Primary 115V 60 Cyc
Sec 18-15-9-0-9-15-18 Volts
5 Amp ......$8.65; 2/$15.75
12 Amp $16.65; 2/29.95
24 Amp* $35.75; 2/69.95
50 Amp* ......$59.00/ 2/$112
100 Amp* ......$108.00; 2/$210
18 Volt. 2 Amps......$1.98
*Dual primary 115 & 230V 60cy

NEW HIGH CURRENT PWR SUPPLIES GTD*



Variable 0-28VDC. Completely Built, Ready to Go, Full Wave Selenium Rectifier, Transformer, Variac, Volt & Amp Meters, Switch, Terminals & Fuse. In Hvy Dty Steel Cabinet. Std 115V **60Cy Input. 110&220V†. 3 phase to order.**

Stock Number	Continuous Rating	With Meters
T28V/5A	0-28 WVDC at 5 Amp	$45.00
T28V5ACC	5 Amp (1% Ripple)	$69.00
T28V12A	0-28 VDC at 12 Amp	$108.00
T28V/12ACC	12AMP(1%Ripple)	$145.00
T28V24A†	0-28 VDC at 24 Amp	$135.00
T28V/24ACC†	24 Amp (1% Ripple)	$195.00
T28V50A†	0-28 VDC at 50 Amp	$260.00
T28V/50ACC†	50 Amp (1% Ripple)	$370.00
T28V100A†	0-28 VDC at 100 Amp	$469.00
T28V/100ACC†	100 Amp(1% Ripple)	$650.00

New! Low Priced Hi Current Basic Supplies

Consisting of Transformer & Full Wave Bridge Rectifier mtd. and wired with no frills, ready to deliver constant DC power.

Stock Number	Continuous Rating	Basic
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B28V/5ACC	5 Amp (1% Ripple)	$49.00
B28V/12A	28 WVDC at 12 Amp	75.00
B28V/12ACC	12 Amp (1% Ripple)	109.00
B28V/24A	28 WVDC at 24 Amp	110.00
B28V/24ACC	24 Amp (1% Ripple)	159.00
B28V/50A	28WVDC at 50 Amp	205.00
B28V/50ACC	50 Amp (1% Ripple)	319.00
B28V/100A	28 WVDC at 100 Amps	395.00
B28V/100ACC	100 Amp(1% Ripple)	499.00

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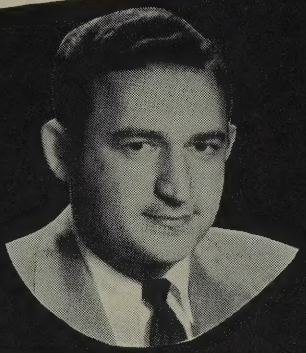

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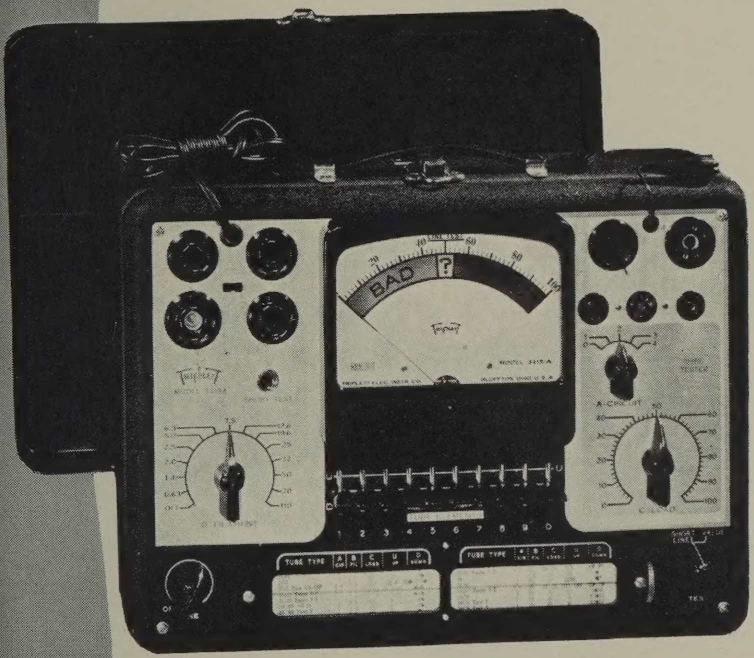

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If you test 3 tubes a day Triplett Model 3413A will **Pay for itself in one year** at the customary checking charge of 10 cents a tube you will write off the cost of only $79.50 in actually less than a year. And you will have

Faster, more accurate testing—Featuring:

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